

Wisconsin Groundwater Coordinating Council

REPORT TO THE LEGISLATURE



August 2002

GROUNDWATER COORDINATING COUNCIL MEMBERS

Department of Natural Resources - Susan L. Sylvester (Chair)
Department of Agriculture, Trade, and Consumer Protection - Nicholas Neher
Geological and Natural History Survey (State Geologist) - James Robertson
Governor's Representative - John Metcalf
Department of Health and Family Services - Dr. Henry Anderson
Department of Commerce - Cathy Cliff
Department of Transportation - Carol Cutshall
University of Wisconsin System - Frances Garb

SUBCOMMITTEE MEMBERS

Research

Geological and Natural History Survey - Ken Bradbury (Chair)
Central Wisconsin Groundwater Center – Paul McGinley
Department of Agriculture, Trade and Consumer Protection - Jeff Postle
Department of Commerce - Harold Stanlick
Department of Health and Family Services - Henry Anderson and Lynda Knobeloch
Department of Natural Resources - David Lindorff and Steve Karklins
University of Wisconsin System - David Armstrong and Maureen Muldoon
U. S. Geological Survey - Jim Krohelski and Randy Hunt

Monitoring & Data Management

Department of Natural Resources – Jeff Helmuth (Chair), Mike Lemcke and Randell Clark
Department of Agriculture, Trade and Consumer Protection – Bruce Rheineck
Department of Commerce - Harold Stanlick
Department of Health and Family Services - Mark Werner
Geological and Natural History Survey - Ron Hennings and Bill Bristoll
University of Wisconsin System – Dave Mechenich
U. S. Geological Survey - Chuck Dunning

Planning and Mapping

Department of Transportation - Bob Pearson (Chair)
Department of Natural Resources - Lisa Morrison and Mike Lemcke
Department of Agriculture, Trade and Consumer Protection – Cody Cook
Department of Commerce - Leroy Jansky
Department of Health and Family Services - Chuck Warzecha
Geological and Natural History Survey - Ron Hennings
University of Wisconsin System - Steve Born
U. S. Geological Survey – Judy Horwathich

Education

Central Wisconsin Groundwater Center - Christine Mechenich (Chair)
Department of Agriculture, Trade and Consumer Protection - Jane Larson and Randy Zogbaum
Department of Commerce - Lynita Docken
Department of Health and Family Services - Lynda Knobeloch
Department of Natural Resources – Tim Asplund and Dorie Turpin
Department of Transportation - Bob Pearson
Geological and Natural History Survey - Ron Hennings
Governor's Representative - John Metcalf
Natural Resources Conservation Service - Jim Kaap
State Laboratory of Hygiene – Amy Mager
University of Wisconsin System - Jim Peterson
U. S. Geological Survey – Chuck Dunning

Local Government

Department of Natural Resources - Dave Lindorff (Chair)
Central Wisconsin Groundwater Center - George Kraft
Council of Regional Planning Organizations - Chuck Kell and Bill Lane
Department of Agriculture, Trade and Consumer Protection - Jim Vanden Brook
Department of Commerce - Roman Kaminski
Department of Health and Family Services - Chuck Warzecha
Geological and Natural History Survey - Ron Hennings
Wisconsin Alliance of Cities - Mayor Carol Lombardi and Mayor John David
Wisconsin County Code Administrators - Ray Schmidt and Bruce Haukom
Wisconsin Rural Water Association - Ed Morse
Wisconsin Water Association - Nancy Quirk



State of Wisconsin \ GROUNDWATER COORDINATING COUNCIL

Scott McCallum, Governor

101 South Webster Street
Box 7921
Madison, Wisconsin 53707
FAX 608-267-7650
TDD 608-267-6897

August, 2002

Susan L. Sylvester,
Council Chair
DNR

To: The Citizens of Wisconsin

The Honorable Governor Scott McCallum
Senate Agriculture and Environmental Resources Committee
Assembly Environment Committee
Assembly Natural Resources Committee
Secretary Gene E. Kussart - Department of Transportation
Secretary Philip Edw. Albert - Department of Commerce
Secretary James E. Harsdorf - Department of Agriculture, Trade & Consumer Protection
Secretary Phyllis Dubé - Department of Health and Family Services
Secretary Darrell Bazzell - Department of Natural Resources
President Katharine Lyall - University of Wisconsin System
State Geologist James Robertson - Geological and Natural History Survey

Carol Cutshall
DOT

James Robertson
WGNHS

Nicholas Neher
DATCP

Henry Anderson
DHFS

Cathy Cliff
COMMERCE

Frances Garb
UWS

John Metcalf
GOVERNOR'S REP.

This is the 2002 Groundwater Coordinating Council (GCC) Report to the Legislature. The GCC was formed in 1984 to help state agencies coordinate non-regulatory activities and exchange information on groundwater. The GCC has served as a model for interagency coordination and cooperation among state government officials, the Governor, local government and the federal government. It is one of the few groups in the nation to effectively coordinate groundwater activities in its state from an advisory position.

This report summarizes GCC and agency activities related to groundwater protection and management in FY 02 (July 1, 2001 to June 30, 2002) and provides an overview of the condition of the groundwater resource. See the *Executive Summary* for highlights and the GCC's recommendations in *Directions for Future Groundwater Protection*. This report is also available online at <http://www.dnr.state.wi.us/org/water/dwg/gcc/RTL-2002.pdf>.

The main focus of the GCC's activities during the past year has been the planning, implementation and follow up to Wisconsin's Groundwater Summit, held in October of 2001. The Summit presented an opportunity to evaluate the State's approach to groundwater management, identify education and research needs, and provide direction for future activities. The document "*Sharing Our Buried Treasure: A Summary of the 2001 Groundwater Summit*" is provided as a companion to the 2002 Report to the Legislature, and is also available online at <http://www.dnr.state.wi.us/org/water/dwg/gcc/SOBT.pdf>.

We hope you, your staff, and the public will find this report to be a useful reference in protecting Wisconsin's valuable groundwater resource.

Sincerely,

Susan L. Sylvester, Chair
Groundwater Coordinating Council

TABLE OF CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS	3
EXECUTIVE SUMMARY	5
INTRODUCTION	8
PURPOSE OF THE REPORT	8
SUMMARY OF WISCONSIN'S GROUNDWATER LEGISLATION	8
COORDINATION ACTIVITIES	10
GROUNDWATER COORDINATING COUNCIL	10
SUBCOMMITTEE ACTIVITY SUMMARIES	12
<i>Research Subcommittee</i>	12
<i>Monitoring & Data Management Subcommittee</i>	13
<i>Planning and Mapping Subcommittee</i>	13
<i>Education Subcommittee</i>	14
<i>Local Government Subcommittee</i>	15
SUMMARY OF AGENCY ACTIVITIES	16
DEPARTMENT OF NATURAL RESOURCES	16
<i>Bureau of Drinking Water and Groundwater</i>	16
<i>Bureau of Waste Management</i>	22
<i>Bureau for Remediation and Redevelopment</i>	23
<i>Bureau of Watershed Management</i>	25
DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION	27
<i>Non-Point Source Activities</i>	27
<i>Point-Source Activities</i>	28
<i>Groundwater Sampling Surveys</i>	28
<i>Research Funding</i>	29
DEPARTMENT OF COMMERCE	29
<i>Private Onsite Wastewater Treatment Systems (POWTS)</i>	30
<i>Petroleum Product and Hazardous Substance Storage Tanks</i>	30
<i>Petroleum Environmental Cleanup Fund Act (PECFA)</i>	31
DEPARTMENT OF HEALTH AND FAMILY SERVICES	31
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY	32
<i>Well Records and Statewide Well Network</i>	33
<i>County and Regional Groundwater Studies</i>	33
<i>Groundwater Research Activities</i>	34
<i>Groundwater Education</i>	36
<i>Recent WGNHS Publications</i>	36
DEPARTMENT OF TRANSPORTATION	37
UNIVERSITY OF WISCONSIN SYSTEM	39
<i>The UW Water Resources Institute (WRI)</i>	39
<i>UW-Extension Water Programs</i>	42
<i>Wisconsin State Laboratory of Hygiene</i>	45
<i>UWS Publications and Presentations Resulting from Joint Solicitation-Funded Research in FY 02</i>	46
FEDERAL AGENCY PARTNERS	48
<i>U.S. Geological Survey: Water Resources Division - Wisconsin District</i>	48
<i>USDA Natural Resources Conservation Service</i>	49
GROUNDWATER MONITORING AND RESEARCH	51

CONDITION OF THE RESOURCE - GROUNDWATER QUALITY	51
<i>Volatile Organic Compounds</i>	51
<i>Pesticides</i>	52
<i>Nitrate</i>	54
<i>Biological Hazards</i>	56
<i>Naturally-occurring Radioactivity</i>	57
<i>Arsenic</i>	58
CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY.....	59
COORDINATION OF GROUNDWATER MONITORING AND RESEARCH	61
<i>The Joint Solicitation</i>	62
<i>Distributing Project Results</i>	63
<i>Other Coordination Activities</i>	63
<i>Table 1: Groundwater Projects Funded through the Joint Solicitation for FY 02</i>	64
<i>Table 2: Groundwater Projects to be Funded through the Joint Solicitation for FY 03</i>	66
BENEFITS FROM MONITORING AND RESEARCH PROJECTS	68
<i>The Atrazine Rule</i>	68
<i>Groundwater Monitoring at Solid Waste Disposal Sites</i>	69
<i>Monitoring for Naturally Occurring Compounds (e.g. Arsenic)</i>	71
<i>Groundwater Movement in Fractured Dolomite</i>	71
<i>Developing New Tools for Groundwater Protection</i>	72
<i>Prevention and Remediation of Groundwater Contamination</i>	73
<i>Biological Effects of Groundwater Contaminants</i>	73
GROUNDWATER DATA MANAGEMENT	74
<i>Department of Natural Resources</i>	74
<i>Department of Agriculture, Trade and Consumer Protection</i>	76
<i>Wisconsin Geological and Natural History Survey</i>	76
<i>Department of Commerce</i>	77
<i>University of Wisconsin System</i>	77
<i>Department of Transportation</i>	77
<i>Department of Health and Family Services</i>	77
DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION	78
PRIORITY RESEARCH & MONITORING ISSUES	78
PRIORITY POLICY & PLANNING ISSUES	78
PRIORITY COORDINATION ISSUES.....	79
APPENDIX	81
MEETING MINUTES – AUGUST 17, 2001	82
MEETING MINUTES – NOVEMBER 10, 2001.....	86
MEETING MINUTES - FEBRUARY 22, 2002	89
MEETING MINUTES – MAY 17, 2002	95
JOINT SOLICITATION PACKAGE FOR FY 03	100
TABLE 3 - GROUNDWATER MONITORING/RESEARCH PROJECTS 1986-2002	116
WISCONSIN FERTILIZER RESEARCH COUNCIL RESEARCH PROJECTS	134
STATUTORY LANGUAGE RELATING TO THE GCC.....	136
LETTER REGARDING AGENCY FUNDING FOR GROUNDWATER MONITORING AND RESEARCH .	138

LIST OF ABBREVIATIONS AND ACRONYMS

AAA	Arsenic Advisory Area
ACCP	Agricultural Chemical Cleanup Program
ASR	Aquifer Storage and Recovery
BMP	Best Management Practices
BRRTS	Bureau of Remediation and Redevelopment Tracking System
CERCLA	Comprehensive Environmental Response Compensation Liability Act
COD	chemical oxygen demand
Comm	Department of Commerce (formerly part of DILHR)
CWGC	Central Wisconsin Groundwater Center
DATCP	Department of Agriculture, Trade and Consumer Protection
DHFS	Department of Health and Family Services
DILHR	Department of Industry, Labor and Human Relations
DNR	Department of Natural Resources
DOT	Department of Transportation
EPA	U. S. Environmental Protection Agency
ERC	Environmental Resources Center
ERS	Division of Environmental and Regulatory Services
ES	Enforcement Standard
ESA	ethane sulfonic acid
FHWA	Federal Highway Administration
FSTRAC	Federal/State Toxicology and Risk Analysis Committee
FY	Fiscal Year
GCC	Groundwater Coordinating Council
GEMS	Groundwater and Environmental Monitoring System
GIS	Geographic Information System
GMU	Geographic Management Unit
GPS	Global Positioning System
GRAC	Groundwater Research Advisory Council
GRN	Groundwater Retrieval Network
IPM	Integrated Pest Management
LUST	Leaking Underground Storage Tank
LWRV	Lower Wisconsin River Valley
mg/L	milligrams per liter
MOU	Memorandum of Understanding
NPM	Nutrient and Pest Management
NRCS	(USDA) Natural Resource Conservation Service
PAL	Preventive Action Limit
PCB	polychlorinated biphenyl
PCR	polymerase chain reaction
PECFA	Petroleum Environmental Clean-up Fund Act
PMP	Pesticide Management Plan
ppb	parts per billion
ppm	parts per million
RR	Bureau for Remediation and Redevelopment
SEWRPC	Southeast Wisconsin Regional Planning Commission
SMP	State Management Plan
SWAMP	System for Wastewater Applications, Monitoring, and Permits
SWAP	Source Water Assessment Program
TDS	total dissolved solids
µg/L	micrograms per liter

UIC.....	Underground Injection Control
USDA.....	US Department of Agriculture
UW.....	University of Wisconsin
UWEX.....	University of Wisconsin Extension
UWS.....	University of Wisconsin System
USGS	US Geological Survey
VOC	volatile organic compound
VPLE.....	Voluntary Party Liability Exemption
WGNHS	Wisconsin Geological and Natural History Survey
WHP.....	Wellhead Protection
WPDES	Wisconsin Pollution Discharge Elimination System
WRI.....	Water Resources Institute
WSLH	Wisconsin State Laboratory of Hygiene
WUWN	Wisconsin Unique Well Number

EXECUTIVE SUMMARY

This is the annual Report to the Legislature by the Groundwater Coordinating Council (GCC) as required by s. 15.347, Wisconsin Statutes. The report describes the condition and management of the groundwater resource and summarizes the Groundwater Coordinating Council's activities for fiscal year (FY) 2002.

In 1984, the Legislature enacted Wisconsin Act 410 to improve the management of the state's groundwater. The GCC is directed by s. 160.50, Wis. Stats., to "serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The Groundwater Coordinating Council shall advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and the appropriation and allocation of state funds for research."

Membership of the GCC includes the Secretaries of the Departments of Natural Resources (DNR); Commerce; Agriculture, Trade and Consumer Protection (DATCP); Health and Family Services (DHFS); Transportation (DOT); the President of the University of Wisconsin System (UWS); the State Geologist; and a representative of the Governor. Agency designees are listed on the inside of the front cover. More information about the GCC and its activities can be found on the GCC web pages: (<http://www.dnr.state.wi.us/org/water/gcc/index.htm>).

Since the last report, the Groundwater Coordinating Council, its Subcommittees, and member State agencies have accomplished the following:

- 1) *The GCC initiated and implemented a statewide meeting of groundwater professionals and interest groups in October 2001, titled Wisconsin's Groundwater Summit.* This Summit presented an opportunity to evaluate the state's efforts in managing and protecting groundwater resources and to provide direction for future education, policy, research, and data management activities. The document "*Sharing Our Buried Treasure: A Summary of the 2001 Groundwater Summit*" is provided as a companion to the 2002 Report to the Legislature, and is also available online at <http://www.dnr.state.wi.us/org/water/dwg/gcc/SOBT.pdf>. Several related activities and outcomes are reported under the section titled *Coordination Activities*.
- 2) *The GCC and the UWS Groundwater Research Advisory Council (GRAC) continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies.* UWS, DATCP, and DNR funded thirty-three projects in FY 02 (see Table 1). The GCC approved the FY 03 joint solicitation package for groundwater research and monitoring, which was sent out in September 2001 (see Appendix). A total of 38 project proposals were received. A comprehensive review process resulted in the selection of 7 new projects for funding for FY 03. At their February 22, 2002, meeting the GCC unanimously approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats. The UWS will fund 7 continuing and 6 new projects in FY 03. The FY 03 groundwater monitoring and research projects are listed by funding agency in Table 2, including 13 projects that were carried over from FY 02.
- 3) *Three GCC Subcommittees participated in a joint effort to produce a set of three Fact Sheets related to comprehensive planning (Smart Growth) and groundwater.* These fact sheets are intended to highlight the need for including groundwater protection in local land use activities and comprehensive planning, provide resources for further information and provide an example of groundwater protection provisions in residential development. The fact sheets were distributed to each of the communities that received comprehensive planning grants, the DNR Land Use Team, and the Wisconsin Land Council. They are also available on the GCC's web page under "Publications" (<http://www.dnr.state.wi.us/org/water/dwg/gcc/>).
- 4) *The GCC released the document "Recommended Minimum Elements for Groundwater Databases" in order to promote the standardization, sharing and exchange of groundwater information.* This document, developed by the Monitoring and Data Management Subcommittee, provides a listing of recommended minimum elements

for groundwater databases to enable users to share data with others more easily. Copies were provided to County Health Departments, state agencies, UW Extension, and university partners. The document is also available on the GCC's web page under "Publications" (<http://www.dnr.state.wi.us/org/water/dwg/gcc/>).

- 5) *The GCC sought to broaden its base of representation and partners through expansion of its Subcommittees.* For example, representatives from the League of Wisconsin Municipalities, and the Southeastern Wisconsin Regional Planning Commission, and the Wisconsin Technical College Board attended meetings in FY 02 and continue to be included in GCC mailings. A representative of the Wisconsin State Laboratory of Hygiene joined the Education Subcommittee in 2001 and contributed a section to this year's report on p. 45. Representatives from the Natural Resource Conservation Service (NRCS) and the U. S. Geological Survey (USGS) continue to attend GCC meetings and serve as *ex officio* subcommittee members.
- 6) *In partnership with the DNR, the Central Wisconsin Groundwater Center hired a statewide Groundwater Guardian program coordinator.* This effort involves using the national Groundwater Guardian program to build the groundwater knowledge and leadership skills of Wisconsin citizens in order to develop a Wisconsin grass-roots groundwater constituency. The program has developed outreach materials including a display, presentation, and brochure; made numerous presentations to interested groups; and assisted the seven existing Wisconsin Groundwater Guardian communities in carrying out their activities. More about the Wisconsin Groundwater Guardian program can be found on the internet: (<http://www.uwsp.edu/cnr/gwguardian>).
- 7) *The Department of Agriculture, Trade and Consumer Protection (DATCP) released the report "Groundwater Quality: Agricultural Chemicals in Wisconsin Groundwater" in May 2002.* Beginning in October 2000 and ending in May 2001, DATCP collected 336 samples from private drinking water supplies to determine the statewide impact of pesticides on groundwater resources. A total of seven common herbicides, ten metabolites and nitrate were included in the latest survey. This study also was compared to previous surveys to attempt to understand trends in groundwater quality over time. Results from this survey have been summarized in the May 2002 report *Groundwater Quality: Agricultural Chemicals in Wisconsin Groundwater* available on the DATCP web site: <http://datcp.state.wi.us/>. Highlights from this overall study show:
 - An estimated 37.7% of wells contain a detectable level of a herbicide or herbicide metabolite.
 - Alachlor ESA and metolachlor ESA are the most commonly detected herbicide compounds with estimates that 27.8 and 25.2% of Wisconsin wells contain these compounds, respectively.
 - A significant decline in parent atrazine concentrations in groundwater occurred between 1994 and 2001.
- 8) *The Department of Natural Resources (DNR) implemented a GIS Registry of Closed Remediation Sites in November 2001.* Revisions to NR 726, 716, 749, and 811/812, Wis. Adm. Code, implement a GIS Registry of Closed Remediation Sites to replace the requirement to record groundwater use restrictions at the County Register of Deeds Office. The GIS Registry currently includes locational information on sites closed with residual groundwater contamination above the NR 140 enforcement standards, as well as specific information pertaining to the location of the contaminant plume and its concentration at the time the closure decision was made. This database is to be used with well construction requirements for private wells, and with a setback distance for new municipal wells.
- 9) *Several State agencies have taken proactive steps to address high arsenic levels in Wisconsin aquifers in FY 02.¹*
 - An Arsenic Web Page (<http://www.dnr.state.wi.us/org/water/dwg/arsenic/index.htm>) has been developed to provide DNR staff and public with information and updated recommendations.

¹ On October 31, 2001 EPA announced that the Federal Drinking Water Standard for arsenic would be lowered from 50 parts per billion for public water systems to 10 parts per billion. The new standard became effective in February 2002 and compliance must be reached by 2006. The arsenic rule affects municipally owned water systems and those that serve an average of at least 25 people daily for six months of the year, among them schools, mobile home parks, apartment buildings, day care centers, and factories.

- Department of Health and Family Services (DHFS) staff completed a DNR-funded study to investigate the relationship between exposure to inorganic arsenic in water and health outcomes. A summary of the final report is available on the DNR's Arsenic Web Page under "Studies." As part of this research effort, local health departments, DNR and DHFS staff, town clerks and others have carried out township-based well sampling campaigns throughout Winnebago and Outagamie counties. More than 2200 families completed questionnaires aimed at assessing arsenic exposure and related health outcomes.
- In FY 02 the WGNHS completed field experiments in the Fox River Valley that evaluated mechanisms of arsenic release to groundwater from domestic wells completed in the St. Peter sandstone aquifer, including studies of arsenic exposure to residents in the area and the effects of well chlorination on arsenic levels. Results of this study were presented to DNR Drinking Water and Groundwater Program staff and used by the DNR to develop well construction guidelines for the Towns of Algoma and Omro.
- Including the two studies mentioned above, a total of 9 DNR and UWS-funded projects addressed issues related to arsenic in FY 02. Two additional studies that have recently been completed include an analysis of the effectiveness of special well construction requirements in high arsenic areas and a study refining analytical methods for detection of arsenic compounds. Ongoing projects include a study of the role of chlorination in releasing arsenic, three projects investigating treatment methodologies for both private and public water supplies, and a new project investigating the occurrence of arsenic in southeastern Wisconsin aquifers. These studies will help provide needed information about the occurrence, health risks, and remediation of arsenic in drinking water supplies. Results will be made available in FY 03 as final reports are completed.

INTRODUCTION

PURPOSE OF THE REPORT

The Groundwater Coordinating Council is required by s. 15.347, Wis. Stats., to prepare a report which "summarizes the operations and activities of the council..., describes the state of the groundwater resource and its management and sets forth the recommendations of the council. The annual report shall include a description of the current groundwater quality of the state, an assessment of groundwater management programs, information on the implementation of ch. 160, Wis. Stats., and a list and description of current and anticipated groundwater problems." This report is due each August. The purpose of this report is to fulfill this requirement for FY 02.

The activities of the Groundwater Coordinating Council and its subcommittees are described in the section titled *Coordination Activities* and in the minutes which are contained in the Appendix. The section *Summary of Agency Activities* describes groundwater management programs and implementation of ch. 160, Wis. Stats., by the individual state agencies. *Groundwater Monitoring and Research* provides information on monitoring and research activities to address groundwater issues in Wisconsin and describes the condition of the groundwater resource. The recommendations of the Council are contained in *Directions for Future Groundwater Protection*.

SUMMARY OF WISCONSIN'S GROUNDWATER LEGISLATION

Wisconsin has a long history of groundwater protection. The culmination of this effort was adoption and implementation of 1983 Wisconsin Act 410, Wisconsin's Comprehensive Groundwater Protection Act, which was signed into law on May 4, 1984. The law expanded Wisconsin's legal, organizational, and financial capacity for controlling groundwater pollution. The Groundwater Protection Act created Chapter 160, Wisconsin Statutes, which serves as the backbone of Wisconsin's program. Chapter 160 provides a multi-agency comprehensive regulatory approach, using two-tiered numerical standards, based on the premise that all groundwater aquifers in Wisconsin are entitled to equal protection. There are a number of major components to Wisconsin's groundwater protection program:

- 1) Standards. Under chapter 160, Wis. Stats., the Department of Natural Resources (DNR) must establish state groundwater quality standards based on recommendations from the Department of Health and Family Services (DHFS). Standard setting is a continuing process based on a priority list of substances detected in groundwater or having a high possibility of being detected, established by the DNR in conjunction with other state agencies. The state groundwater standards are contained in chapter NR 140, Wisconsin Administrative Code. For each substance there is an enforcement standard (ES) which determines when a violation has occurred and a preventive action limit (PAL) which is set at a percentage of the ES. The PAL serves as a trigger for possible remedial action.
- 2) Regulatory Programs. Once groundwater quality standards are established, all state agencies must manage their regulatory programs to comply. Each state regulatory agency must promulgate rules to assure that the groundwater standards are met and to require appropriate responses when the standards are not met. The state regulatory agencies are the DNR (solid and hazardous waste, industrial and municipal wastewater, spills, wetlands and water supply); the Department of Commerce (private sewage systems, petroleum product storage tanks); the Department of Agriculture, Trade and Consumer Protection (DATCP) (pesticide use and storage and fertilizer storage); and the Department of Transportation (DOT) (salt storage). The implementation of the groundwater standards by the state agencies is described under "Summary of Agency Activities".
- 3) Aquifer Classification. One of the most important features of Wisconsin's groundwater law is an item that was omitted. When Wisconsin was debating the groundwater protection legislation, the U. S. Environmental Protection Agency (EPA) tried to develop a nationwide groundwater approach. A keystone of EPA's proposal was aquifer classification - a scheme whereby each aquifer would be classified according to its potential use, value or vulnerability, and then would be protected to that classification level. This entails "writing off" certain

aquifers as industrial aquifers not entitled to protection and never again usable for human water supply. Wisconsin said "no" to aquifer classification. The philosophical underpinning of Wisconsin's groundwater law is the belief that all groundwater in Wisconsin must be protected equally to assure that it can be used for people to drink today and in the future.

- 4) Monitoring and Data Management. At the time the groundwater legislation was created, there was concern that Wisconsin needed a groundwater monitoring program to determine whether the groundwater standards were being met. Therefore, a groundwater monitoring program was created under s. 160.27, Wis. Stats. Money from the Groundwater Account of the Environmental Fund has been used for problem-assessment monitoring, regulatory monitoring, at-risk monitoring, and management-practice monitoring, as well as establishment of a data management system for collection and management of the groundwater data. See the "Groundwater Monitoring and Research" discussion in this report for further information.
- 5) Research. Although all state agencies must comply with the groundwater standards, the processes by which groundwater becomes contaminated, the technology for cleanup, the mechanisms to prevent contamination, and the environmental and health effects of the contamination are often not well understood. In addition, the basic data on geology, soils, and groundwater hydrology is often not available. The UWS and the state agencies have recognized that additional efforts in these research areas are badly needed. The Governor and the Legislature included a new groundwater research appropriation for the UWS beginning with the 1989-1991 biennial budget. Since 1992, the UWS, DATCP, DNR and Commerce have participated in a joint solicitation for groundwater-related research and monitoring proposals. See the "Groundwater Monitoring and Research" section for more details.
- 6) Coordination. In establishing the groundwater law, the Legislature recognized that management of the state's groundwater resources was a responsibility divided among a number of state agencies. Therefore, the Groundwater Coordinating Council was created to advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater. The Coordinating Council has been meeting since 1984. See the "Coordination Activities" discussion in this report.
- 7) Local Groundwater Management. The Groundwater Protection Act clarified the powers and responsibilities of local governments to protect groundwater in partnership and consistent with state law.
 - a. Zoning authority for cities, villages, towns and counties was expanded to "encourage the protection of groundwater."
 - b. Counties can adopt ordinances regulating disposal of septage on land (consistent with DNR requirements); cities, villages, or towns may do so, if the county does not.
 - c. Counties can regulate (under DNR supervision) well construction and pump installation for certain private wells.
 - d. Property assessors must consider the time and expense of repairing or replacing a contaminated well or water supply when assessing the market value of real property; they must consider the "environmental impairment" of the property value due to the presence of a solid or hazardous waste disposal facility.

The following report is intended to update the Legislature and Governor on the status of the state's groundwater program and the activities of the Groundwater Coordinating Council.

COORDINATION ACTIVITIES

GROUNDWATER COORDINATING COUNCIL

The Groundwater Law, 1983 Wisconsin Act 410, established the GCC to advise and assist state agencies in coordinating non-regulatory programs and exchanging groundwater information. The GCC consists of the heads of all state agencies with some responsibility for groundwater management plus a Governor's representative. The agency heads have appointed high-level administrators with groundwater responsibilities to sit on the Council. The state agencies include the DNR, Commerce, DHFS, DATCP, DOT, WGNHS, and the UWS. The GCC has created five subcommittees to assist in its work. The subcommittees are composed of approximately 60 people including members of the GCC, employees of state and federal agencies, university researchers and educators, representatives of counties and municipalities and public members. Additionally the DNR has one permanent position with half of its responsibilities related to coordination of the GCC.

The GCC had four meetings during the past year. The meeting minutes are included in the Appendix. The following activities are highlighted and summarized here.

Wisconsin Groundwater Summit. In May of 2000, the GCC initiated an effort to assess the current status of groundwater management in the state and to provide future direction for the GCC and its member agencies. This effort culminated in an event called "Wisconsin's Groundwater Summit" held on October 30, 2001 in Waukesha, WI. The Summit brought together a broad spectrum of groundwater users and stakeholders to discuss issues facing groundwater protection and management and develop solutions to better protect Wisconsin's groundwater. Representatives from over 50 organizations, agencies, and other groups with a stake in safe and adequate groundwater supplies attended the meeting. These included environmental, conservation, and agricultural groups, industrial users, water utilities, local and tribal government, planning agencies, state and federal agencies, and university researchers and educators. The Summit structure included a set of keynote presentations and a panel discussion, followed by breakout sessions where participants were asked to address specific issues and suggest solutions. A core group of GCC Subcommittee members helped to synthesize the discussion and formulate a set of findings and recommendations that are contained in the document *Sharing Our Buried Treasure: A Summary of the 2001 Groundwater Summit* available online at <http://www.dnr.state.wi.us/org/water/dwg/gcc/SOBT.pdf>.

A number of other products and follow-up activities resulted from the Groundwater Summit, which are also summarized on the GCC Summit web page (<http://www.dnr.state.wi.us/org/water/dwg/gcc/GCC-GWSUMMIT.HTM>.) These include:

- Development of a "Breakout Session Matrix", which compiles over 435 specific comments, ideas, or needs identified by the Summit participants in the afternoon breakout sessions.
- Review of the breakout session comments by each of the GCC Subcommittees and development of goals or directions for further action in the areas of Research, Monitoring and Data Management, Mapping, and Education.
- Preparation of press releases immediately following the Summit and during Groundwater Awareness Week providing information on key ideas discussed at the Summit.
- Interaction with the Waters of Wisconsin Project of the Wisconsin Academy of Sciences, Arts and Letters, including making findings available for the project report and developing a follow-up session for the Waters of Wisconsin Forum to be held in the fall of 2002.

The GCC will continue to follow up on the Summit findings in the context of the Wisconsin Waters of Wisconsin Initiative and through the GCC's ongoing meetings and Subcommittees. Full Summit proceedings will be made available by the end of 2002.

Smart Growth Fact Sheets. Members of three subcommittees participated in a joint effort to produce a set of three fact sheets related to comprehensive planning (Smart Growth) and groundwater. These fact sheets are intended to

highlight the need for including groundwater protection in local land use activities and comprehensive planning, provide resources for further information and give examples of groundwater protection ordinances for residential developments. The fact sheets were distributed to each of the communities who has received comprehensive planning grants, the DNR Land Use Team, and the Wisconsin Land Council. Information will also be sent to local government organizations to share with their membership. They are also available on the GCC's web page under "Publications" (<http://www.dnr.state.wi.us/org/water/dwg/gcc>).

Minimum Data Elements. The GCC released the document *Recommended Minimum Elements for Groundwater Databases* in order to promote the standardization, sharing and exchange of groundwater information. This document, developed by the Monitoring and Data Management Subcommittee, provides a listing of recommended minimum elements for groundwater databases to enable users to share data with others more easily. Copies were provided to County Health Departments, state agencies, UW Extension, and university partners. The document is also available on the GCC's web page under "Publications" (<http://www.dnr.state.wi.us/org/water/dwg/gcc>).

Joint Solicitation. The GCC and the UWS Groundwater Research Advisory Council (GRAC) continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. (Details are found in the section on *Coordination of Groundwater Monitoring and Research*). The GCC approved the FY 03 Joint Solicitation package in August of 2001 (see Appendix). Members of 2 GCC Subcommittees reviewed the proposals that were submitted and made their recommendations to the agencies and GRAC. Three GCC members participated in the GRAC review. At their February 22, 2002 meeting the GCC unanimously approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats.

State budget shortfalls limited the number of new projects that were selected for funding during FY 03. The GCC directed that a letter be sent to the secretary of each of the agencies represented on the GCC asking that funding for groundwater monitoring and research activities be restored in future years. A copy of the letter is included in the Appendix.

Several improvements were made to the Joint Solicitation process in FY 02, including the debut of online proposal submittal and the development of an electronic database for coordinating reviews and managing projects. In addition, a meeting was held between the GCC staff person, DATCP staff, and the manager of the Wisconsin Fertilizer Research Council to explore ways of coordinating and streamlining the two proposal review and funding processes. These activities will help create efficiencies in the proposal submittal process and help ensure that taxpayer dollars are directed at the most pressing needs for groundwater information.

Other coordination activities. The GCC continued to promote communication, coordination, and cooperation between the state agencies through its quarterly meetings. The GCC received briefings and heard presentations on:

- Subcommittee activities (see below)
- FY 03 Joint Solicitation
- 2001 GCC Report to the Legislature
- UWS FY 03 Groundwater Research Plan
- Ideas for improving Joint Solicitation review process
- Agency groundwater budgets
- Planning for and outcomes of the Wisconsin Groundwater Summit
- Source Water Assessment Program (SWAP)
- Monitoring and modeling of nonpoint pollution in agricultural fields
- DATCP survey of agricultural chemicals in private wells
- Water system security issues
- Waters of Wisconsin Initiative of the Wisconsin Academy of Sciences, Arts and Letters
- Passage of microorganisms in septic system effluents through mound sand
- Performance monitoring of Private Onsite Wastewater Treatment Systems (POWTS) by Commerce
- Source water modeling of Sauk County
- Access to well information on the DNR internet site

WWW site. Several updates to the World Wide Web site for the GCC have been made in the past year (<http://www.dnr.state.wi.us/org/water/dwg/gcc/>). The site provides information on the activities of the council, a list of members on the council and members of the subcommittees, information on the annual Joint Solicitation for groundwater research proposals, documents in web viewable and downloadable format, and links to other relevant groundwater or related web sites. Links can also be found to GCC-related information on other institution's web sites, including research summaries at the Water Resources Institute and a karst information web page at the WGNHS.

SUBCOMMITTEE ACTIVITY SUMMARIES

The GCC is directed to "serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management". The Subcommittees of the GCC carry out this charge by regularly bringing together staff from over 15 different agencies, institutions, and organizations to communicate and work together on a variety of research, monitoring and data management, planning and mapping, educational, and local government issues.

In addition to the specific Subcommittee activities reported below, several collaborative efforts among agencies and Subcommittees were accomplished in FY 02. In addition, numerous contacts and informal conversations are generated both at meetings and through email communications among Subcommittee members, leading to better communication across agency lines on a variety of issues. These activities related to participation of agency staff on GCC Subcommittees create efficiencies and provide intangible benefits to Wisconsin's taxpayers. For example:

- At Farm Progress Days, groundwater-related booths sponsored by UW-Extension, WGNHS, CWGC, DNR, DHFS, Comm, and DATCP were located in one tent, providing drinking water screening for nitrate and information on drinking water quality, drinking water treatment and backflow prevention, healthy homes, proper disposal of agricultural chemicals, and proper sealing of abandoned wells.
- Members of the Education, Planning and Mapping, and Local Government Subcommittees developed three comprehensive planning and groundwater fact sheets, titled "Groundwater and its Role in Comprehensive Planning", "Resources to Help You Protect Your Drinking Water Supply", and "Residential Development and Groundwater Resources."
- Through agency reports and discussion at the Education Subcommittee meeting, DHFS and DATCP corrected a gap in communication with private well owners about the results of pesticide testing.
- Through discussion at several Subcommittee meetings, access to well locational information in DNR's groundwater and drinking water databases was restored to several agencies, and the importance of this information as a public resource was emphasized as a priority for DNR consideration.
- Through discussion of the DNR's source water protection program, DOT learned of the need to locate salt storage facilities for their source water protection maps. DOT recently implemented a new salt storage inspection program and had similar needs. The DOT was able to obtain GPS coordinates for salt storage facilities as part of their routine inspections and in doing so was able to provide the DNR with geographic locations of 1,193 salt storage facilities.

Research Subcommittee

The purpose of the Research Subcommittee is to assist the GCC in establishing priorities for groundwater research and monitoring activities and to review proposals submitted through the joint solicitation process. To this end, the subcommittee reviewed and revised the priorities for the DNR's groundwater management practice monitoring

program for FY 03. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, Commerce, and DATCP in September 2001.

The subcommittee met with the Monitoring and Data Management Subcommittee in January 2002 to review the 38 proposals that were received as a result of the joint solicitation. Subcommittee members made recommendations that were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for FY 03. The projects to be funded in FY 03 are listed in Table 2.

Monitoring & Data Management Subcommittee

The goal of the Monitoring & Data Management Subcommittee (MDMS) is to coordinate groundwater monitoring and data management activities of state agencies to maximize value and efficiency. MDMS members continued to work collectively, individually, or in small groups on GCC activities or action items targeted by the subcommittee. In FY 02 progress was made on the following issues:

- The MDMS reviewed the priorities for the DNR's groundwater management practice monitoring program for FY 03. The subcommittee met with the Research Subcommittee in January to review the 38 research and monitoring proposals that had been received in response to the joint solicitation. Subcommittee members made recommendations that were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for FY 03. The projects to be funded in FY 03 are listed in Table 2.
- A document of "Recommended Minimum Data Elements" was completed. This document was written over the last several years and was influenced by the DNR's Locational Data Standards guidance and the National Water Quality Monitoring Council's draft *Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes*. The document was produced as guidance for Wisconsin data managers on how to select and use data elements when constructing groundwater databases.
- A computer application was developed to make the karst reporting form available for electronic data entry and storage. The program features on-screen data entry, creation of an automated database, online help features, the ability to upload or attach files to the form (jpg, gif, Word, etc.), search capability, and an export/import function. Users will be able to create their own karst database on their computer and share files with other users or ultimately with the WGNHS. This is part of a larger effort to create a statewide database of karst features and is also beneficial to people with existing databases.
- Several subcommittee members took part in the Groundwater Summit held in October of 2001, contributing to follow-up work synthesizing the ideas presented and putting together a strategy to guide future management activities. The subcommittee as a whole helped to prioritize research and monitoring/data management needs that were identified in the Summit breakout sessions.

A continuing goal for the MDMS is for members to communicate on each program's monitoring programs and data management activities to prevent duplication and increase the utility of monitoring results. This goal is met through regular meetings where members can update one another on their agencies' activities. In FY 02 the subcommittee met three times to track important monitoring and data management issues such as the confidentiality requirements of 1999 Wisconsin Act 88, outside access to DNR databases, arsenic and pesticide monitoring results, electronic data submission through the DNR's Well Forms Program and web page, the DNR's FY 02 Groundwater Monitoring Plan, source water assessment program data management, and agency access of well sample data through the DNR's Groundwater Retrieval Network (GRN) on the DNR's Bureau of Drinking Water and Groundwater web page.

Planning and Mapping Subcommittee

The purpose of the Planning and Mapping Subcommittee is to help the State integrate groundwater management and protection strategies into local and regional land use planning with an emphasis on identifying and prioritizing specific physical (water quantity) and chemical (water quality) hydrogeologic mapping needs (natural resources and anthropogenic impacts). During this reporting period the Subcommittee has been in a state of transition with the

selection of a new chairperson and selection of replacement subcommittee members. The subcommittee held meetings on December 5, 2001 and April 3, 2002 during this reporting period.

Progress continues in implementing karst feature inventories and mapping goals. Accomplishments and activities in this long-term project of establishing a statewide karst database and creating regional or local maps includes:

- Assisting with the development of a karst informational brochure produced by the Rock River Coalition, Inc. and the UW-Extension, with funds through the Environmental Quality Incentives Program Educational Assistance funds of the USDA. The brochure is used statewide for educational outreach to teach the public and private sector the importance of karst features and how easily groundwater can be contaminated in karst environments. Many new environmental regulations reference special criteria for groundwater protection in karst settings (e.g., waste facility location requirements, stormwater infiltration requirements, and environmental remediation requirements). The brochure received the 'Gold Award' in the promotional materials category by the Association of Natural Resources Extension Professionals, a national award.
- Presenting a talk at the American Water Resource Association (Wisconsin Section) conference to promote the use of the voluntary karst feature inventory reporting form.
- Meeting in a small workgroup to continue development of a database, factoring in the demonstration of a karst inventory electronic form developed by the MDMS.

Pursuant to s. 16.967 (6), Wis. Stats., eleven State Agencies are required to annually submit Plans to Integrate Land Information to the Wisconsin Land Information Board. These plans were due March 31, 2002 and they are intended to enable such information to be readily translatable, retrievable and geographically referenced for use by any state, local government or public utility. The current focus of the subcommittee is to review these plans to determine if there is a subset of groundwater specific land information that can be compiled in a reference index catalog, which can be updated annually for the use of groundwater practitioners.

A key activity of the subcommittee is providing Agency updates of groundwater related mapping efforts. This important communication enables each Agency to share information and not duplicate efforts. This year, for example, DOT learned that the DNR source water protection program needed to locate salt storage facilities among many other items (e.g., landfills, environmental clean-up sites, etc.) for their source water protection maps. DOT recently implemented a new salt storage inspection program and had similar needs. The DOT was able to obtain GPS coordinates for salt storage facilities as part of their routine inspections and in doing so was able to provide the DNR with geographic locations of 1,193 salt storage facilities. This interagency communication continues to be a focus for the subcommittee.

Education Subcommittee

The Education Subcommittee met five times during the past year. Its mission is to review public information and education materials, coordinate educational messages among agencies, and serve as a forum to identify groundwater education needs, ideas and concerns. At each meeting, representatives share information about current agency activities related to groundwater.

The subcommittee coordinated agency activities for large events such as National Drinking Water Week and Wisconsin Farm Progress Days. At Farm Progress Days in Rock County in September, 2001, groundwater-related booths sponsored by UW-Extension, WGNHS, CWGC, DNR, DHFS, Comm, and DATCP were located in one tent. Exhibits provided drinking water screening for nitrate and information on drinking water quality, drinking water treatment and backflow prevention, healthy homes, proper disposal of agricultural chemicals, and proper sealing of abandoned wells.

The subcommittee also provided input and volunteer help for the Groundwater Summit, and analyzed the results to identify education needs and themes for future action. Groundwater quantity education, which the subcommittee is continuing to develop, was one of the needs identified by the Summit. The subcommittee also provided input into

revisions to brochures on pesticides in drinking water, nitrate in drinking water, and common questions about groundwater. It discussed the need to balance the educational benefits of public access to well information on the Internet with privacy and security concerns following September 11.

The Education Subcommittee regretfully accepted the resignations of two long-time members, Bob Pearson of DOT and Jane Larson of DATCP, because of additional responsibilities assigned to their positions, but welcomed Randy Zogbaum as the new DATCP representative.

Local Government Subcommittee

The Local Government Subcommittee (LGS) was formed in 1993 to represent local units of government and organizations representing local units of government. The subcommittee was created by the GCC in response to recommendations from the 1991 conference “Working Together to Manage Wisconsin’s Groundwater – Next Steps?” The purpose of the Subcommittee is to serve as a means of communicating local government issues and concerns about groundwater protection to the state agencies that make up the GCC, as well as to allow the GCC and its subcommittees to share information and get input about documents and publications.

The Subcommittee has met infrequently in recent years because there haven’t been issues requiring its attention. It did meet on October 10, 2000 to discuss how best to utilize the Subcommittee to meet the needs of local governments. There was a consensus that the Groundwater Summit being discussed by the GCC could serve as an impetus for providing new directions for the LGS, as well as identifying new people or groups to become involved. It was decided that the group would wait to meet until the results of the conference could be evaluated. The Groundwater Summit was held October 30, 2001.

The Subcommittee met by conference call on May 1, 2002 to provide updates on current activities and get input from Subcommittee members. Some new members and additional persons were invited to participate in the call. The Subcommittee heard updates on follow-up to the Groundwater Summit, progress on comprehensive planning and groundwater fact sheets, the source water assessment program, Comm 83 and other activities. The Subcommittee provided comments on the directions for Groundwater Summit follow-up, the fact sheets and future directions for the Subcommittee. Participants agreed to meet in the fall of 2002 and focus on ways the Subcommittee could be involved in promoting discussion of groundwater quantity issues and options for regionalization of water management.

SUMMARY OF AGENCY ACTIVITIES

The groundwater management efforts undertaken by the member agencies of the Groundwater Coordinating Council during the past year show that Wisconsin continues to have a strong commitment to protection of its groundwater resource.

DEPARTMENT OF NATURAL RESOURCES

The DNR has statutory authority as the central unit of state government to protect, maintain and improve groundwater within the state (s. 144.025(1), Wis. Stats.). The DNR establishes the groundwater quality standards for the state under authority of s. 144.025(2)(b) and ch. 160, Wis. Stats. The DNR also has specific groundwater-related regulatory programs.

DNR regulatory programs to protect groundwater are the responsibility of four Bureaus:

1. Bureau of Drinking Water and Groundwater – Regulates public water systems, private drinking water supply wells, and high capacity wells. The Groundwater Section assists in coordinating groundwater activities of the DNR, as well as other state agencies. In particular, the Groundwater Section is responsible for adoption of groundwater standards contained in ch. NR 140, Wis. Adm. Code; development of an annual groundwater monitoring plan; coordination of the joint solicitation for groundwater-related monitoring and research proposals; review and management of groundwater monitoring projects; coordination of groundwater components of basin plans and of nonpoint source priority watershed projects; coordination of wellhead protection and source water assessment activities; and maintenance of a data management system for groundwater data. <http://www.dnr.state.wi.us/org/water/dwg/index.htm>
2. Bureau of Waste Management - Regulates and monitors groundwater at proposed, active, and inactive solid waste facilities and landfills. The Bureau reviews investigations of groundwater contamination and implementation of remedial actions at active solid waste facilities and landfills. The Bureau also maintains a Groundwater and Environmental Monitoring System (GEMS) database of groundwater quality data from over 600 solid waste facilities and landfills and uses reports from GEMS to evaluate whether sites are impacting groundwater quality. <http://www.dnr.state.wi.us/org/aw/wm/index.htm>
3. Bureau for Remediation and Redevelopment - Oversees response actions at spills, hazardous substance release sites, abandoned containers, brownfields (including the Site Assessment Grant program), “high priority” leaking underground storage tanks, closed wastewater and solid waste facilities, hazardous waste corrective action and generator closures, and sediment cleanup actions. A significant amount of the RR program’s work relates to groundwater contamination. <http://www.dnr.state.wi.us/org/aw/rr/index.htm>
4. Bureau of Watershed Management - Regulates the discharge of municipal and industrial wastewater, by-product solids and sludge disposal from wastewater treatment systems and wastewater land treatment/disposal systems. The Bureau also issues WPDES permits for discharges associated with clean-up sites regulated under the authority of the Bureau for Remediation and Redevelopment. The Bureau also has primary responsibility for regulating stormwater and agricultural runoff as well as managing waste from large animal feeding operations. <http://www.dnr.state.wi.us/org/water/wm/index.htm>

Bureau of Drinking Water and Groundwater

Groundwater Standards. Chapter 160, Wis. Stats., requires the DNR to develop numerical groundwater quality standards, consisting of enforcement standards and preventive action limits, for substances detected in, or having a reasonable probability of entering, the groundwater resources of the state. Chapter NR 140, Wis. Adm. Code,

establishes these groundwater standards and creates a framework for their implementation. There are currently groundwater quality standards for 122 substances of public health concern, 8 substances of public welfare concern and 15 indicator parameter substances in ch. NR 140.

Amendments are currently being proposed to ch. NR 140 to add groundwater quality standards for 2 substances, alachlor ESA (ethane sulfonic acid) and molybdenum, and to revise existing groundwater quality standards for 3 substances: butylate, dacthal and naphthalene. All of these substances are potentially of public health concern. At its June 2002 meeting, the Natural Resources Board authorized public hearings on these proposed amendments to NR 140. These hearings have been scheduled for the end of August and early September of 2002.

Groundwater Section staff serve on the Bureau for Remediation and Redevelopment - Standards and Streamlining Team. This team identifies policy issues, develops guidance, and provides training regarding the implementation of chs. NR 720, 722, 724 and 726 dealing with soil cleanup standards, selecting and implementing remedial actions and case closures. The team is also responsible for developing additional NR 720 soil standards, supporting groundwater standards development and streamlining the cleanup process.

Section staff also serve on the Bureau for Remediation and Redevelopment - NR 700 Implementation Team. This team evaluates and makes recommendations promoting consistency for statewide issues affecting the DNR's Bureau for Remediation and Redevelopment. These issues include site investigations, soil and groundwater remediation, and general case closure decisions. The team's function is critical in obtaining statewide consistency on how the Bureau for Remediation and Redevelopment evaluates, addresses and closes soil and groundwater contamination sites.

Section staff serve on the Federal/State Toxicology and Risk Analysis Committee (FSTRAC). This group, comprised of representatives from several states and EPA, provides a forum for the exchange of information and ideas related to water quality, public health and drinking water.

The Groundwater Section published revisions to the DNR's Groundwater Sampling Desk Reference and Field Manual in 1996. These documents provide detailed instructions on how to consistently collect high quality, representative groundwater samples and make accurate monitoring measurements. Both the Groundwater Sampling Desk Reference and Field Manual have been widely distributed and well received by both environmental professionals and the regulated community. The two documents are available on the Bureau of Drinking Water and Groundwater's web page at <http://www.dnr.state.wi.us/org/water/dwg/gw/sample.htm>. They are among the top most downloaded documents on the Bureau's web page.

Groundwater Monitoring and Data Management. DNR continues to administer funds for management practice monitoring projects. During FY 02, \$436,285 was spent on 14 projects selected during the joint solicitation process described under *Groundwater Monitoring and Research* in this report. Approximately \$128,000 was awarded to 6 projects for management practice monitoring during FY 03. Two projects are new studies selected during this year's joint solicitation process (see Tables 1 and 2).

Under direction of the GCC, the UW Water Resources Institute (WRI) and the Groundwater Section continued to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. Final reports and 2-page research summaries are available for most projects. Almost 100 summaries are available electronically on the following WRI web page (<http://www.wri.wisc.edu/wgrmp/wgrmp.htm>).

Final reports received by the DNR in FY 02 include:

Bahr, J.M. and L. Parent. 2002. An Improved Hydrogeologic Model for the Token Creek Watershed.

Benson, C.H. and T. Lee. 2002. Using Waste Foundry Sands as Reactive Media in Permeable Reactive Barriers.

Connelly, J., D. Dinsmore, T. Hegeman, B. Shaw, R. Stephens, N. Turyk, and J. Schultz. 2002. Evaluating options for changing groundwater monitoring requirements for landfills to reduce mercury used by laboratories.

Eaton, T.T, K.R. Bradbury, and H.F. Wang. 2002. Verification and Characterization of a Fracture Network within the Maquoketa Shale Confining Unit, Southeastern Wisconsin.

Groundwater Section staff continue to implement NR 141 Groundwater Monitoring Well Requirements. Activities include consultation on well construction with Remediation and Redevelopment, Waste Management, Watershed Management and Department of Commerce staff, consultants and drillers. Additional educational efforts on code application involve inspections of drilling operations and training sessions at Department of Commerce PECFA staff meetings. Random inspections of environmental drilling operations help educate drillers and consultants about NR141 requirements and enhance compliance with the code. Review of new technologies and their application also continue to be a priority.

The DNR's Well Forms Program continues to provide users the ability to electronically data enter, print, export, and import information from eight Department related well forms. The software includes the following forms: Monitoring Well Construction Form 4400-113A, Monitoring Well Development Form 4400-113B; Well/Drillhole/Borehole Abandonment Form 3300-5B; Soil Boring Log Information Form 4400-122 and 122A; Groundwater Monitoring Well Information Form 4400-89; Groundwater Monitoring Inventory Form 3300-67; First Water Quality Report Form (3300-77); and the Drinking Water Well Construction Report Form (3300-77A). Several upgrades were completed this past year to several of the forms to add additional capabilities based on user requests.

The Well Forms Program software was originally introduced in conjunction with special Wisconsin Unique Well Number (WUWN) tags specifically designed for monitoring wells. Since 1988, all drinking water supply wells were assigned a WUWN. Now all wells, public, private and monitoring, constructed in the state of Wisconsin require a WUWN be associated with it.

Wellhead Protection. The DNR is the lead state agency for developing and implementing the Wisconsin Wellhead Protection (WHP) Plan. The specific goal of Wisconsin's plan is to achieve groundwater pollution prevention in public water supply wellhead areas consistent with the state's overall goal of groundwater protection. To achieve this goal the DNR, working with other state and federal agencies and extensive citizen input, developed a two-part state WHP Program that was approved by the USEPA in 1993. A WHP plan must be developed for any new municipal water supply well constructed since May 1, 1992. The plan must be approved by the DNR's Public Water Systems Section. A WHP Plan is voluntary for any public water supply well approved prior to May 1, 1992; the DNR promotes and encourages but does not require wellhead protection planning for existing wells.

The DNR continues a statewide public information effort aimed at encouraging water utilities to protect their water supplies from potential sources of contamination through wellhead protection planning. Wellhead protection activities are coordinated through a Wellhead Protection Standing Team created in January of 1998. Among the activities undertaken this past year were:

- *Teacher training.* Department staff worked with the Central Wisconsin Groundwater Center (CWGC) and the Wisconsin Geological and Natural History Survey to sponsor three groundwater workshops for teachers in February. Teachers from 24 school districts were given training in the use of the groundwater sand tank model and given the models to take back to their schools. Forty-eight teachers took part in the workshops held in Eau Claire and Green Bay. In addition to the models, teachers were given a variety of educational materials and an assignment to report how they used the model in their classroom. The intent is to provide information for teachers to educate students –and their parents – to protect groundwater in their own communities.
- *Working with local communities on WHP planning.* Three Groundwater Section staff share responsibility for assisting communities with preparing wellhead protection plans. Staff meets with communities, provide information, and make presentations to promote the WHP program. The DNR also works with the Wisconsin Rural Water Association in providing assistance. Information is shared with local communities through a spring and fall wellhead protection newsletter.

- *WHP publications.* The DNR makes publications available to assist communities in their wellhead protection efforts. Work has been completed on three fact sheets to assist communities in addressing groundwater in their comprehensive plans. The three fact sheets (*Groundwater and Its Role in Comprehensive Planning, Resources to Help You Protect Your Drinking Water Supply* and *Residential Development and Groundwater Resources*) will be available in paper copy and through the web. An effort will be made to share these fact sheets with local units of government. The publication "Determining Wellhead Protection Area Boundaries - An Introduction" has recently been added to the WHP web page (next item).
- *Upgrading the DNR's WHP web pages.* The Department continues to update its WHP web pages (<http://www.dnr.state.wi.us/org/water/dwg/gw/whp.htm>) as new information becomes available. It currently includes general information on WHP, an annotated bibliography, a list of contacts for more information, a list of available publications, example WHP ordinances, and past and present issues of the Wisconsin Wellhead Protection News. Several DNR publications have been added to the web page in viewable and downloadable formats. In 2001, the example ordinances were updated and a listing of the 168 communities with wellhead protection plans was placed on the web page.
- *Keeping track of wellhead protection activity.* The Department has developed a database to keep track of communities working on wellhead protection planning, whether required or voluntary. The Department is working to incorporate into the Department's Public Water System database a tracking system for both wellhead protection and source water assessment activities.
- *Promoting the Groundwater Guardian Program.* The Department contracted with the Central Wisconsin Groundwater Center (CWGC) to hire a person to promote the Groundwater Guardian program statewide. The person prepared materials, made presentations to encourage local governments to become Groundwater Guardian communities, worked with existing Groundwater Guardian communities and organized the second annual statewide meeting of Groundwater Guardian communities.
- *Coordinating efforts with the Source Water Assessment Program.* The WHP Team continues to work closely with the Source Water Protection Team to provide consistency and continuity between the two programs. One area where the teams are working together is promoting advanced WHP Area delineations. In order to provide the most accurate information available to assist in WHP planning, the DNR has funded or is funding regional groundwater modeling projects in all or parts of 24 counties (see Source Water Assessment discussion below). In addition to providing a valuable planning tool for communities in these counties, the projects will provide delineations of the 5, 50 and 100-year capture zones for each of the municipal wells in these areas. Communities can use these delineations in their WHP planning process.

With the source water assessment set-aside funds from EPA set to expire next year, the Department plans to request wellhead protection set-aside funds from EPA to complete the source water assessments and provide help to communities in using their assessments to develop wellhead protection plans.

Source Water Assessments. The DNR received USEPA approval of Wisconsin's Source Water Assessment Program (SWAP) Plan in November 1999. The plan was submitted to meet the requirements of the 1996 Safe Drinking Water Act Amendments. The purpose of the program is to assess the risks that potential sources of contamination pose to public drinking water supplies, both groundwater and surface water. The program will: 1) delineate source water protection areas for all public water systems in the state; 2) conduct inventories of significant potential sources of contamination within those areas; 3) perform an analysis of susceptibility for each system; and 4) make the results of the assessments available to the public.

Source water areas for municipal groundwater systems are being delineated through regional groundwater flow modeling studies. These studies are being completed for the Lower Fox Valley, Central Sands Area, and the following counties: Dane, Eau Claire, Fond du Lac, Kenosha, La Crosse, Milwaukee, Ozaukee, Pierce, Racine,

Rock, Sauk, St. Croix, Walworth, Washington, and Waukesha. For the other municipal systems and smaller systems, simple radius delineations are being used.

In coordination with the State's Vulnerability Assessment Program, maps of source water areas are sent to each system with a request for system operators to identify potential contaminant sources within the delineated areas. Additionally, through SWAP, the DNR is collecting potential contaminant-source location data from existing databases and from field projects by the Remediation and Redevelopment, Waste Management, and Watershed Management programs as well as from other State agencies.

The types and locations of potential sources of contamination will be used with well construction, hydrologic, geologic, and other information to determine each system's susceptibility to contamination. The results of the assessments will be sent to drinking water systems and made available on the Internet. The goal of Wisconsin's SWAP is to provide information that will assist communities in preparing WHP plans.

Coordination of groundwater components of basin plans and of nonpoint source priority watershed projects.

Groundwater Section staff work with basin teams to develop specific groundwater priorities for watershed basins or Geographic Management Units (GMU). Priorities are based on GRN data, land cover information and information provided by regional DG program staff. For example, the Rock River Coalition Groundwater Issues Team has focused on cataloging data and resources, identifying contaminant sources and karst features, developed an award-winning karst brochure and promoted well abandonment demonstrations.

During FY 01, Geographic Management Units (GMU) around the state began the process of developing State of the Basin reports with direction from Water Division and Land Division guidance on integrated planning. State of the Basin Reports have been completed for all 23 basins in the state. State of the Basin (or GMU) reports provide baseline information on surface water, groundwater and land resources. Their main focus is on priority issues that are identified by the respective GMU team, made up of department staff and partnership groups. The plans identify geographic priorities for the nonpoint source program and will be used to help rank projects eligible for nonpoint source grant funds. The Groundwater Section is involved in integrated planning by providing basic data on groundwater for each GMU and more detailed information as is needed. The Section is uniquely suited to highlight areas in need of management based on groundwater issues and nonpoint source priority areas related to groundwater.

New Runoff Management rules with performance standards for stormwater infiltration will be promulgated in FY 03. Groundwater Section staff are working with Runoff Management staff to make sure the rules comply with chapter NR 140, Wis. Adm. Code. The Section is also participating on a team writing guidance for developers, land use planners and government agencies regarding stormwater practices that will meet the performance standards while preserving groundwater quality.

Arsenic in Groundwater. In 1999 the Bureau of Drinking Water & Groundwater established a statewide Arsenic Study Group. This Group was established because of the increased incidence of arsenic in wells, primarily in NE Wisconsin; the effects of a potential federal drinking water standard change; and unresolved drilling method and construction specification issues. The Arsenic Study Group includes DNR Drinking Water & Groundwater staff, representatives from other State agencies, EPA, the United States and the Wisconsin Geological Surveys, UW System, UW Extensions, Local County Health Departments, the National Institute of Health, and the Wisconsin Water Well Association. The group's purpose was to assist the state in its effort to proactively understand and develop solutions for the arsenic issue and its related health impacts.

Over the last year work has continued on the Arsenic Study Group recommendations. Efforts included data collection and analysis, public and private well sampling, treatment system testing, developing drilling specifications, health effects studies and educational efforts. Many of the recommendations have been completed, while some studies are ongoing. A web page (<http://www.dnr.state.wi.us/org/water/dwg/arsenic/index.htm>) has been developed to provide DNR staff and public with information and updated recommendations.

On October 31, 2001 EPA announced that the Federal Drinking Water Standard for arsenic would be lowered from 50 parts per billion for public water systems to 10 parts per billion. EPA had previously delayed the rule in order to look at new studies regarding the health effects and to analyze economic issues associated with arsenic especially costs to small systems. The new standard became effective in February 2002 and compliance must be reached by 2006. The arsenic rule affects municipally owned water systems and those that serve an average of at least 25 people daily for six months of the year, among them schools, mobile home parks, apartment buildings, day care centers, and factories.

The Bureau will work with affected water systems to determine what this new standard means for them and what their options are. The Bureau is tracking current and new technologies for treating arsenic that may be possibilities for small water systems in Wisconsin. The DNR will continue to urge EPA to make funding available specifically for arsenic treatment for small systems that will have trouble covering the cost of expensive treatment systems.

Another component of the Department's efforts at implementing the new standard is giving careful consideration to new well construction so as to increase the chance for low-arsenic water, as follows:

- 1) Require a specified well casing restriction zone in order *to protect the aquifer from oxygen introduction*. Wells constructed according to this restriction may not provide water that meets the drinking water standard but are intended to minimize the impact of wells as an additional source of oxygen which exasperates aquifer degradation by arsenic.
- 2) Require that an arsenic water sample be collected at each new well in the restriction area. This provides a mechanism for continued public awareness and data evaluation.

Underground Injection Control (UIC) Program. Public water utilities in Oak Creek and Green Bay are continuing to work with the Bureau of Drinking Water and Groundwater to evaluate the use of aquifer storage recovery (ASR)² techniques in Wisconsin:

- The Oak Creek ASR pilot study has been approved to proceed with an additional injection-storage-recovery cycle in order to gather additional water quality information. A final report on the portion of the research that was funded by the American Water Works Association Research Foundation (AWWARF) should soon be available.
- The Green Bay ASR pilot system is expected to become operational in the latter part of the year. The Department has concerns about the potential for adverse geochemical reactions that would result in the mobilization of arsenic found in the regional bedrock. The Department has conditioned its approval of the proposed demonstration test plan to ensure that these potential interactions are more precisely monitored.

The Bureau of Drinking Water and Groundwater continues to work with the United States Environmental Protection Agency (EPA) to revise the primacy agreement that gives the DNR primary enforcement for Wisconsin's Underground Injection Control (UIC) program. The Department is required to revise the existing regulatory agreement to reflect newly enacted federal regulations that address a variety of injection practices. Failure to establish a new agreement may result in the direct implementation of federal Underground Injection Control program requirements by EPA.

As part of the activities to revise the state/federal primacy agreement, the DNR had proposed to create Chapter NR 815, Wis. Adm. Code. This new chapter was to have served as a template that demonstrated how existing state administrative rules would have continued to impose state regulatory requirements that were as least as stringent as

² ASR systems involve the injection of treated drinking water via a well into a suitable bedrock aquifer. The injected water is stored underground until the time it is needed to meet the needs of a utility's customers. During a high demand event the stored drinking water is pumped back up the same injection well and recovered into the water distribution system with little need for additional treatment to remove potential drinking water contaminants.

the new federal regulations. During its review of the proposed chapter, the Wisconsin Legislature requested that modifications be made to the section regarding the visitorial powers of the DNR. The Department is working to resolve this issue and has indicated to EPA that a revised primacy application cannot be completed and submitted until after the new administrative rules are in place. EPA has not yet responded regarding a new deadline for submitting the UIC program primacy application.

High Capacity Wells. The Department of Natural Resources is authorized under statute to regulate wells on each property where the combined capacity of all wells on the property, pumped or flowing, is greater than 70 gallons per minute. Such wells are defined as high capacity wells. When the operation of a high capacity well is anticipated to have an adverse impact on the quality or quantity of water available to a public utility well, the Department is obligated to deny approval or to limit operation of the high capacity well so that their operation does not adversely impact a public utility well.

Groundwater quantity and water withdrawal issues have received more than usual attention in recent years, prompted by the interest of a major water bottling company in locating a high capacity well near two spring sites. The Department is continuing to address the potential impacts of the proposed wells through the review and approval process. This project highlighted the limited authority that the state has in regulating groundwater withdrawals that may affect surface water resources.

Drinking Water and Groundwater web site. The Bureau continues to expand its Drinking Water and Groundwater web site (<http://www.dnr.state.wi.us/org/water/dwg/index.htm>). The site provides information on arsenic, the Perrier issue, capacity development, the plan review process for community water systems, groundwater, the Groundwater Coordinating Council, operator certification information, private and public water systems, underground injection well information, well driller and pump installer information and DNR Drinking Water & Groundwater staff. Access to many of the program's paper forms is available through the web site. Four online databases are also accessible through the site links. In addition, several new site segments were added this last year and many of the existing links were greatly expanded with new or additional information and materials.

Bureau of Waste Management

The Bureau of Waste Management regulates and monitors groundwater at proposed, active, and inactive solid waste facilities and landfills. The Bureau also reviews investigations of groundwater contamination and implementation of remedial actions at active solid waste facilities and landfills.

Over the past few years increasing numbers of residential developments have been located close to old, closed landfills. To recommend ways to ensure integration and communication within the DNR when addressing the problem of private wells near old, closed landfills, an ad hoc team, the Landfill Encroachment Work Group, was formed with members from the Bureaus of Waste Management, Remediation and Redevelopment, and Drinking Water and Groundwater. The work group's goal was to work together to prevent people from drinking contaminated groundwater from private wells near landfills and locating homes where this may already be occurring. The work group made the following recommendations to help avoid old, closed landfills from impacting private wells:

1. improve our database of the location and characteristics of active, inactive and abandoned landfills across the state;
2. provide easy access to that list through the Internet and other more traditional media for developers, realtors, planners and potential homeowners;
3. work with these external groups to determine what information would be the most valuable to them; and
4. rank unmonitored old, closed landfills to determine which of these sites should be investigated to determine if there are private wells nearby that should be sampled.

The three bureaus involved in the workgroup have taken several steps to implement the recommendations listed

above. Information is being collected for a GIS layer of locations for all the sites listed on the Registry of Waste Disposal Sites using Global Positioning System (GPS) and digitizing from blueprint plan sheets. In 2000 and 2001 we digitized the location of 230 landfills with plan sheets and have begun GPS locating smaller landfills that do not have plan sheets. Landfill characteristics are also being collected for all the Registry Sites. In the future, we hope to link the two databases and provide this information to potential homeowners, planners, realtors, and others using a mapping interface.

The Bureau of Waste Management was also concerned staff was not aware of some old, closed landfills that are impacting groundwater. Program staff used several reports from the Groundwater and Environmental Monitoring System to do a rough screening of old, closed town, city and village landfills with monitoring wells. Every two years the program runs the screening reports, identifies landfills that need further attention and sends the list to each of the regions for follow-up evaluations.

Over the past two years the bureau has studied 31 landfills accepting municipal solid waste, to try to determine whether VOC contamination in groundwater at these landfills is increasing, decreasing or remaining stable. We chose sites with 10 years of data and summarized the trends over this period of time. One purpose of this study was to determine whether natural attenuation is occurring in groundwater near leaking landfills. The findings of this study will be available in September 2002.

The Bureau of Waste Management and the UW Stevens Point received funding from July 1999 to July 2001 to evaluate the effectiveness of chemical oxygen demand (COD) as an indicator parameter at landfills. One reason for evaluating COD is that mercury waste is generated when COD is analyzed in the laboratory. The Department's overall goal is to reduce amount of mercury that gets into the environment so eliminating COD sampling at the 400+ landfills that currently sample for it would help us meet that goal. Findings from the first year of the study indicate that there is potential to eliminate COD monitoring at some types of landfills. The second year of the study evaluated possible alternatives to sampling for COD and the findings are available from the Bureau upon request.

Bureau for Remediation and Redevelopment

The Bureau for Remediation and Redevelopment is primarily responsible for implementing and aiding cleanups under the Spill Law, the Environmental Repair Law, federal programs (Superfund, Hazardous Waste Corrective Action, LUST, Brownfields), the Land Recycling Law and State Brownfield Initiatives and at closed landfills. All cleanups are conducted according to WI Administrative Rules NR 700-750, Investigation and Remediation of Environmental Contamination, and NR 140, Groundwater Quality. Persons responsible under the laws, or those persons or groups involved in the redevelopment of potentially contaminated properties, do the majority of cleanups. Program staff provide assistance on cleanups conducted by consultants at responsible parties direction, and contract with and direct consultants on state-funded cleanups.

Cleanup of groundwater contamination. The program used the Environmental Fund to initiate or continue environmental cleanup actions at approximately 45 locations where groundwater contamination is known or suspected. The Environmental Fund is used when contamination is significant but private parties do not undertake the cleanup because no one has legal responsibility for the contamination, the person(s) legally responsible do not have the financial ability to proceed, or the responsible person simply refuses to proceed. Private contractors conduct these cleanups with oversight by Department staff. The program spends an average of \$5 million per year from the fund to address contamination at new and continuing project sites. Whenever feasible, the RR program and legal staff attempt to recover costs from responsible persons after the cleanups are undertaken.

Brownfields program. In FY 02, the RR program continued to implement the Brownfields Site Assessment Grant (SAG) program. This program provides grants to local governmental units to conduct environmental site assessments and other eligible activities at contaminated properties. Eligible activities include site assessment and investigation, demolition, asbestos abatement, removal of petroleum and hazardous substance storage tanks and removal of abandoned containers. The SAG program benefits groundwater by serving as a funding source for (1)

removal of potential sources of groundwater contamination, and (2) site investigations to determine whether groundwater is contaminated, including the determination of the extent and degree of contamination. The SAG program does not fund remediation activities but funds preliminary activities to determine whether remediation is necessary.

Eligible sites are abandoned, idle or underused industrial or commercial facilities or sites whose expansion or development is adversely affected by actual or perceived environmental contamination. Sites are eligible for funding only if the persons responsible for the contamination are unknown, cannot be located, or cannot pay for the activities for which grant funding is requested. In FY 02 the DNR received applications for 73 sites requesting a total of approximately \$3.12 million. Of this the Department awarded \$1.7 million in grants to 34 different local governmental units at 54 sites. These grants will fund the removal of 94 aboveground and underground storage tanks and 151 abandoned drums and other containers of hazardous substances. These grants will also be used to fund 30 environmental site investigations. In two years the program has existed, grants were awarded to a total of 103 properties around the state.

The RR program continues to provide redevelopment assistance at brownfield sites with groundwater contamination. RR staff assist local governments and private businesses with the cleanup and redevelopment of abandoned or under-used properties where redevelopment is hindered by contamination. In many cases these properties have groundwater contamination or contamination that poses a threat to groundwater. Also, the RR program continues to provide a number of different assurance letters related to properties with groundwater contamination. General Liability Clarification Letters provide assurances to parties involved with voluntary cleanup sites so that they can buy or redevelop brownfield properties without concern about liability. "Off site" letters are provided to owners of property who demonstrate that the contamination under their properties did not originate on the property. These letters facilitate development of the property while the Department provides oversight of the cleanup being conducted by the person responsible for the contamination. In addition, lease letters are provided to lessees who rent properties overlying contaminated groundwater. These letters clarify the activities that lessees may undertake in order to remain free of liability for the contamination. Other assurance letters are also provided to lenders and local governments.

The RR program also continues to assist parties with voluntary investigations and cleanups of Brownfield properties through the Voluntary Party Liability Exemption (VPLE) process. After a person has conducted an environmental investigation of the property, and cleaned up soil and groundwater contamination, the Department will issue a "Certificate of Completion" which provides a release from future liability for any contamination that occurred on the property prior to issuance of the certificate. In FY 02, there were 9 completed cleanups where the Department issued a Certificate of Completion.

In March of 2001, the RR program began allowing parties to obtain a Certificate of Completion for sites that have not met groundwater standards if they could demonstrate that natural attenuation is effective and they paid for environmental insurance coverage (see the section below for further discussion of natural attenuation closure). The state has entered into this insurance policy to cover the cost to cleanup contaminated groundwater if natural attenuation fails at VPLE sites. As of July 2002, two cleanup sites have paid for this insurance to protect groundwater in case natural attenuation fails and obtained a Certificate of Completion.

Dry Cleaner Environmental Response Fund (DERF) Program. The DERF program reimburses dry cleaner owners and operators for eligible costs associated with the cleanup of soil and groundwater at sites contaminated by dry cleaning solvents. Fees paid by the dry cleaning industry provide program funding. Environmental cleanup at dry cleaner sites will be conducted following the NR 700 rule series. To date, there are more than 65 sites in the program, at various stages of investigation and cleanup. The program is implemented through ch. NR 169, Wis. Adm. Code.

Site closure rules for Petroleum Contaminated Sites (under PECFA). NR 746 (and its counterpart, Comm 46) was promulgated in February 2001. The bulk of the rule establishes risk and closure criteria to determine whether petroleum contaminated sites can be closed using natural attenuation as a final remedy for groundwater

contamination. NR 746 also defines which petroleum-contaminated sites DNR and Department of Commerce have authority to administer; summarizes site investigation requirements, and delineates other administrative requirements such as when remediation and remediation funding is terminated, tracking and transfer of sites, staff training and dispute resolution. The rule provides that sites with contamination in low permeability (clay) materials can close after a site investigation if all risk criteria are met and the groundwater contamination is stable or receding. For contamination in permeable materials, sites must meet all risk criteria and demonstrate through monitoring that groundwater contaminants are declining. A groundwater use restriction must be recorded for sites closed with groundwater contamination above NR 140 enforcement standards. Depending on the extent of soil contamination remaining at a contaminated site, a deed restriction may also be required.

NR 726 provides closure requirements for all other sites.

GIS Registry. Revisions to NR 726, 716, 749, and 811/812 implement a GIS Registry of Closed Remediation Sites to replace the requirement to record groundwater use restrictions at the County Register of Deeds Office. These revisions went into effect in November 2001, along with a corresponding database on the Internet. The GIS Registry currently includes locational information on sites closed with residual groundwater contamination above the NR 140 enforcement standards, as well as site specific information pertaining to where the contamination is on the property in question and at what concentration it was found at the time the closure decision was made. This database is to be used with well construction requirements for private wells, and with a setback distance for new municipal wells. The Department is providing the information from the database to Diggers' Hotline. When well drillers contact Diggers' Hotline before drilling, Diggers' Hotline will then inform the Department that a well is proposed for a property listed on the Registry. The Department will then contact the driller and advise them that special well construction features may be necessary, and that they must contact the Bureau of Drinking Water and Groundwater prior to any well construction activities.

Starting in fall, 2002, the GIS Registry will be expanded to include sites closed with residual soil contamination, including those sites closed with soil deed restrictions. The same type of locational and site specific information will be included for these sites as is currently included on the GIS Registry for sites with residual groundwater contamination. Inclusion on the GIS Registry on the Internet will provide a means of notifying future owners or users of the property of the existence of soil contamination.

Another database, the Bureau of Remediation and Redevelopment Tracking System (BRRTS) has been available on the Internet for public access for the 2 past years. These two databases are linked for greater ease of information access. BRRTS is useful for locating potential contamination sites when evaluating new municipal well placement. These databases make site specific information on open and closed remediation sites much more available and accessible to the public and specific interested groups, particularly those wanting to install or replace a potable well on an affected property, as well as those buying properties. Sites regulated by the Departments of Commerce and Agriculture, Trade and Consumer Protection are also included in the GIS Registry of Closed Remediation Sites and BRRTS.

Bureau of Watershed Management

The Bureau of Watershed Management is responsible for statewide implementation of DNR's Groundwater Standards Program primarily through the issuance of discharge permits to facilities, operations and activities that discharge treated wastewater and residuals to groundwater. Field staff that work on integrated basin teams carry out compliance and enforcement activities using policies, codes and guidelines developed by the Bureau. Integrated basin planning carried out in the field under guidelines developed by the Bureau, assess and evaluate groundwater (and surface water) and provide general and specific recommendations for the protection and enhancement of the basin's groundwater.

Wastewater Discharges. The Bureau of Watershed Management continued to issue WPDES permits to all communities, industrial facilities, and large privately owned wastewater systems which discharge treated domestic or industrial wastewater to groundwater through land treatment/disposal systems. These systems are primarily

spray irrigation, seepage cell, subsurface absorption systems, and ridge & furrow treatment systems. WPDES permits, issued to these facilities, contain groundwater monitoring and data submittal requirements which are used to evaluate facility compliance with ch. NR 140, Wis. Adm. Code, groundwater quality standards. Groundwater monitoring systems at existing facilities are evaluated and upgraded, as necessary, at permit re-issuance.

The Bureau of Watershed Management continues to assist unsewered communities, served by failing or inadequate individual on-site treatment systems in their efforts to construct centralized wastewater treatment facilities.

The Department is continuing to refine procedures, guidance, and rules for the review and permitting of large private onsite wastewater treatment systems (POWTS). The DNR started issuing permits to large POWTS in early 2000, as a result of changes to Commerce Rules and a revised DNR/Commerce MOU. In general, large POWTS are defined as those with a capacity of greater than 12,000 gallons per day (gpd). The Department is proceeding with a revision to ch. NR 200, Wis. Adm. Code, to clarify how the 12,000-gpd criteria will be established in situations involving multiple systems that are commonly owned and located close together.

Septage and Sludge Management - The Bureau of Watershed Management implements the regulations in chapters NR 113, NR 204 and NR 214, Wis. Adm. Code. NR 113 relates to septage management and NR 204 governs the treatment quality, use, and disposition of municipal wastewater treatment plant sludge. NR 113 and NR 204 incorporate federal septage and sludge standards. The Bureau regulates the land application of industrial sludge, liquid wastes and by-product solids through NR 214. Chapters NR 113, NR 204 and NR 214 contain treatment quality standards and land application site requirements and restrictions that are designed to prevent runoff to surface water or leaching of nutrients and pollutants to groundwater.

The Bureau continues to develop and implement a new statewide computer system that records and monitors treatment and disposal of municipal sludge, septage, and industrial land applied wastes. This system includes an inventory and a history of all sites used for land application. Wisconsin became the fourth state delegated authority by EPA to implement municipal sludge regulations, through its delegated NPDES (WPDES) permit program, in July of 2000.

Agricultural Runoff - There are currently 105 Wisconsin Pollutant Discharge Elimination System (WPDES) permits issued under the NR 243 permitting program for livestock operations (78% dairy; 11% poultry; 11% swine & beef). The Department recently issued a single permit to a group of poultry operations, some of which were covered under an individual permit. While this has resulted in an overall decrease in the number of permits issued, the overall number of operations covered under a permit has increased significantly. In addition, there are 10 dairy operations seeking permits for the first time. Regional and central office staff have successfully maintained the permit backlog at less than 10%. The trend of growing numbers of permit applications for operations with 1,000 or more animal units is expected to continue.

Rules outlining statewide performance standards and prohibitions for agricultural operations (nutrient management, manure storage design, clean water diversion, erosion control) are expected to become effective in October of 2002. The performance standards and prohibitions have been a key component of the Department's Nonpoint Redesign Initiative and are intended to further address impacts from animal feeding operations with less than 1,000 animal units.

At the federal level, the US EPA is continuing efforts to revise regulations for Concentrated Animal Feeding Operations (CAFOs) to be completed by December of 2002. Department staff provided comments on an EPA request for additional input on a number of topics including the use of non-NPDES programs to address operations with fewer than 1,000 animal units and the use of Environmental Management Systems.

Storm Water – DNR is currently working on revising its storm water regulations under ch. NR 216, Wis. Adm. Code, in order to comply with federal storm water regulations to take effect by March 10, 2003. Storm Water Phase 2 regulations will require nearly 200 municipal separate storm sewer systems to obtain permit coverage statewide and also require construction sites down to one acre of land disturbance to have permit coverage to

control erosion during construction. Permit holders will also be required to install post-construction practices to limit pollutant discharge after construction is completed (storm water management). The Department has developed performance standards (i.e. 80% sediment control, infiltration, peak flow, buffer requirements, etc.) that have passed the legislature and are expected to become effective about October 2002. Many of these standards will be implemented through storm water permits, especially for new development. However, there are certain delays built into the performance standard rules including a 2-year delay for implementation of the storm water management performance standards.

Nutrient Management Plans – One of the performance standards included as part of the Redesign effort was a nutrient management standard, NRCS Standard 590. During 2000 and 2001, DATCP and DNR conducted public hearings and proposed changes to their non-point pollution control rules to include nutrient management standards and practices. These rules were adopted by the Natural Resources Board in spring of 2002 and subsequently passed legislative review. The rules will be promulgated in October 2002.

For more information, contact Susan Sylvester at 608-266-1099 (Susan.Sylvester@dnr.state.wi.us), or Mike Lemcke at 608-266-2104 (Michael.Lemcke@dnr.state.wi.us), DNR, PO Box 7921, Madison, WI 53707-7921.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

Protecting Wisconsin's groundwater is a priority for the DATCP. DATCP's major activities in this area include management of pesticides, research, and funding of local soil and water resource management projects.

Under the Wisconsin Groundwater Law, DATCP manages pesticides and pesticide practices to assure that established groundwater standards for contaminants are not exceeded. This may include prohibition of certain activities including pesticide use. The agency also manages practices to "minimize" groundwater contamination to the extent "technically and economically feasible." DATCP regulates storage, handling, use, and disposal of pesticides, and the storage of bulk quantities of fertilizer.

DATCP is also responsible for coordinating the development of Wisconsin's "generic" and "pesticide-specific" state pesticide management plans (PMPs - previously known as SMPs) for protecting groundwater from pesticides. In FY 96, DATCP, in cooperation with DNR and other agencies, submitted Wisconsin's "Generic SMP for Protection of Groundwater from Pesticides" to the EPA for concurrence. EPA concurred with the Generic SMP in June 1996. According to the EPA document "Pesticides in Groundwater Strategy" (1991), when EPA determines that a pesticide presents a significant risk of leaching to groundwater in a state, it may either cancel the registration of that compound or allow the state to prepare an PMP describing how the state will manage the pesticide to protect groundwater. The generic PMP presents a comprehensive review of Wisconsin's regulatory and non-regulatory efforts to prevent groundwater contamination due to pesticides. This generic plan will serve as a framework for pesticide-specific PMPs that will be required by the EPA for four commonly used herbicides.

Enforcement standards have been established in Wisconsin for many known and potential groundwater contaminants, including over 30 pesticides. Standards for additional pesticides have been proposed. DATCP applies these standards and the Groundwater Law when addressing nonpoint and point sources of pesticide contamination in groundwater.

Non-Point Source Activities

DATCP's primary effort related to nonpoint contamination (i.e., due to general use) of groundwater continues to involve the herbicide atrazine. In response to concerns about atrazine contamination, DATCP amended administrative rule ch. ATCP 30 in 1992 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Rule revisions have been made annually in response to additional detections of atrazine in groundwater. Rule revisions for the 2002 growing season increased the total acreage of

atrazine use prohibition areas, based on groundwater sample results available as of September 2001. A set of 101 maps of new or existing prohibition areas is available from the Water Quality Section covering 1.2 million acres that have been incorporated into the rule. Information suggests that atrazine use has declined as a result of the atrazine management rule and concern about groundwater contamination.

DATCP, through its land and water resource management program, provides funding primarily to counties to assist in the protection of these resources. A portion of this funding is dedicated to the development and implementation of improved nutrient and pesticide management practices. In FY 02 approximately \$200,000 was provided to promote the adoption of nutrient management plans on farms to maximize profitability and to minimize excessive runoff of nutrients to surface and groundwater.

Point-Source Activities

Previous DATCP and DNR surveys have identified significant point sources of contamination of groundwater quality at pesticide storage and handling facilities. These surveys indicated that activities at these sites continue to result in groundwater contamination, putting nearby private and, in some cases, municipal wells at risk. Surface water run-off from contaminated areas can also result in direct human and livestock exposure, property damage and/or surface water contamination.

In August 1993, section 94.73 of the Wis. Stats. was created and established the Agricultural Chemical Cleanup Program (ACCP) to address these point sources of contamination. The ACCP reimburses responsible parties for cleanup costs related to pesticide and fertilizer contamination at facilities and in nearby wells. The program may also handle point source contamination on farms. To date, more than 350 cases involving soil and/or groundwater remediation related to spills, misuse, and improper storage, mixing or loading have been initiated at pesticide and fertilizer handling facilities and on farms.

The ACCP also funds DATCP oversight of pesticide and fertilizer cleanup activities. Program staff investigate pesticide and fertilizer contaminated sites throughout the state. Investigations at these sites are prioritized based on suspected contamination levels, with higher levels investigated first. Investigations include discussions with facility staff or farmers to determine the most likely locations of contamination at the site. Other oversight activities include, but are not limited to, sample collection, laboratory analysis, and financial auditing.

In addition, a pilot pollution prevention program was initiated in 2001. This program is an attempt to promote proper handling of agricultural chemicals to prevent future contamination at commercial facilities. A lead-arsenate program was also created. The goal of this program is to educate landowners of potential lead-arsenate contamination at former fruit orchard sites across the state. The program also provides assistance for remediation of contaminated sites.

Since 1990, the Agricultural Clean Sweep program has helped farmers dispose of unwanted pesticides, farm chemicals, and empty pesticide containers. Beginning in 1996, the program extended collection services to small agricultural businesses. In FY 02 DATCP provided \$365,411 to fund Clean Sweep projects in 37 counties for collection and disposal of waste pesticides and containers. Approximately 220,961 pounds of waste were reducing the potential for inadvertent environmental damage. Approximately \$350,000 will be available during FY 03 for these projects.

Groundwater Sampling Surveys

DATCP participates in a number of surveys on an annual basis to investigate the occurrence of pesticides in groundwater resulting from nonpoint sources. Results of these surveys are provided in the "Pesticides" section under *Condition of the Resource - Groundwater Quality*.

Exceedence Survey. From 1995-2001 DATCP has conducted an annual sampling program of private wells that have previously exceeded a pesticide enforcement standard. 150 wells have been re-sampled at least once in this

program for common pesticides and nitrate. Most of the wells are in atrazine prohibition areas. In 2001, 71 private wells that have historically exceeded groundwater standards were sampled.

Pesticide and Groundwater Impacts Study. In 1985, DATCP began a study to determine if normal field application and use of pesticides and fertilizer was causing groundwater contamination at highly susceptible sites (e.g. sandy soils, less than 25 ft. to groundwater). In 2001, this study entered its 16th program year. As many as 50 different field sites have been sampled. Currently 25 sites are being monitored across the state. DATCP's Water Quality Section maintains this network of monitoring wells primarily as an early warning system for pesticides new to the marketplace.

Monitoring Reuse of Atrazine in Prohibition Areas. In FY 98, DATCP began monitoring the limited reuse of the herbicide atrazine in selected areas where atrazine use has been prohibited. Ch. ATCP 31, Wis. Adm. Code, requires DATCP to collect scientific data to show if renewed use of atrazine in prohibition areas will cause further groundwater contamination. DATCP is monitoring groundwater quarterly at 17 fields, 10-40 acres in size, for 5 years. In 2001, 278 samples were collected in this program.

Atrazine Rule Evaluation Survey. In 1994 and 1996, DATCP completed groundwater sampling surveys designed to evaluate the effectiveness of the Atrazine Rule (ch. ATCP 30, Wis. Adm. Code). These surveys were designed to determine how levels of atrazine and its metabolites in groundwater were changing three and five years after the atrazine restrictions went into effect. In 2000 and 2001, Water Quality Section staff sampled 336 private wells across the state that included 122 of the same wells sampled in 1996. Results from this survey have been summarized in the May 2002 report "Groundwater Quality: Agricultural Chemicals in Wisconsin Groundwater", which may be downloaded at http://datcp.state.wi.us/arm/agriculture/land-water/water-quality/monit_proj.html.

Research Funding

DATCP funded three pesticide research projects during FY 02 with a total commitment of \$170,000 over two years. Two-year projects were funded to 1) evaluate pesticide and nitrate leaching on soils receiving manure, 2) evaluate agrichemical residues in two groundwater basins, and 3) to determine the occurrence of antibiotics in wastewater effluents and their mobility in soils. DATCP's research fund, which is based on fees paid by pesticide manufacturers, provides approximately \$135,000 annually to meet pesticide related research needs of the Department.

For further information, visit the following web site (<http://datcp.state.wi.us>) or contact Nicholas Neher, DATCP, 2811 Agriculture Drive, PO Box 8911, Madison, Wisconsin, 53708-8911; phone: 608-224-4567; e-mail: nicholas.neher@datcp.state.wi.us.

DEPARTMENT OF COMMERCE

Chapter Comm 10, Wis. Adm. Code, regulates flammable and combustible liquids and hazardous substance liquids on the CERCLA list. The regulatory authority for the storage tank program is within the Division of Environmental and Regulatory Services (ERS) in the Department of Commerce. The ERS Division has two bureaus: Bureau of Petroleum Products and Tanks, and the Bureau of PECFA.

Under 145.02, Wis. Stats., the Department of Commerce also has the responsibility of safeguarding public health and the waters of the state relative to the construction, installation and maintenance of plumbing. One mechanism of the Department to fulfill this responsibility is to promulgate a state plumbing code, chapters Comm 81-87. Chapter Comm 83 that addresses Private Onsite Wastewater Treatment Systems is part of the state plumbing code, and is administered by the Division of Buildings and Safety.

Private Onsite Wastewater Treatment Systems (POWTS)

A revised private onsite wastewater treatment systems (POWTS) code, Comm 83, was implemented on July 1, 2000. Audits of the county onsite sewage system programs indicate that even with the availability of additional onsite treatment options, based on plan review and permit activities, most property owners are choosing to install the same types of onsite systems that were available under the previous code. Nine manuals for standard system designs are referenced in the code. The majority of the designs are being selected from the conventional, mound, pressure distribution, at-grade, and holding tank component manuals. The quality of written management and contingency plans that are now required for each onsite system design continues to improve. These plans are intended to alert the owners of onsite systems to the need for regular inspection, servicing and/or maintenance. These plans provide for mandatory system maintenance schedules and reporting of maintenance events over the life of the system. To help insure that the maintenance is properly performed, training classes and workshops for "POWTS Maintainers" continue to be offered by private vendors and the University of Wisconsin – Extension. The number of registered POWTS Maintainers continues to increase. This will help insure that the maintenance requirements are met. The Department initiated a "fix-up" Comm 83 code package that is intended to correct errors and clarify certain provisions in the current code. A code council was formed and has met several times to discuss issues and offer recommendations to the Department.

Petroleum Product and Hazardous Substance Storage Tanks

The ERS division continues to maintain regulatory oversight of the Federal EPA Underground Storage Tank (UST) upgrade compliance deadline that was December 22, 1998. Systems that did not meet the upgrade requirements after the deadline were "red-tagged" and taken out of service. Some facilities were placed in a "temporary-out-of-service" status and given one additional year to upgrade or be permanently closed. Prior to October 1999 Wisconsin State Statute did not designate or authorize the Department regulatory authority for the non-flammable/combustible hazardous substance tanks included in the federal rule. Hazardous substance tanks have been brought into regulatory authority by 1999 Wisconsin Act 9, but, have not at this time been implemented through administrative rule, which is currently under revision.

Since 1991 the database inventory of petroleum product tanks regulated under Comm 10 has increased from 143,681 to 175,539 tanks as previously unregistered tanks have become registered. In 1991 the database included 68,056 tanks classified as federally regulated with 51,088 of those tanks in use. As of June 17, 2002 the database reflects 78,597 federally regulated tanks with only 12,753 tanks in use. In order to maintain a federally regulated tank in use, the tank must have a valid "permit-to-operate," which is complimented by an annual inspection. Annual inspections involve verification of leak detection, spill and overfill protection, and record keeping. Permit renewal administrative review includes compliance assessment of the owner's financial responsibility.

Program initiatives have resulted in identifying a larger population of underground tanks, reducing the number of underground tanks in use, and upgrading those in use to meet the 1998 federal upgrade requirements. The closure of federally regulated tanks will continue, but at a slower pace than experienced over the past few years. Closure of out-of-service residential heating fuel tanks is continuing at a strong pace as realtors and lenders recognize the potential problems and liability.

The closure of underground storage tanks is being supplanted by private fueling moving to retail fueling and some operators moving storage tanks to above ground. Residential heating fuel has not been significantly impacted, as the closures are generally associated with the conversion to natural gas or liquid propane gas (LPG). Existing aboveground bulk storage facilities were subject to release prevention upgrade requirements in 2001 providing an enhanced measure of environmental protection over the former levels of acceptance.

Proactive educational outreach efforts and annual inspections by the Department and its agents have resulted in a high level of regulatory compliance, and a reduction of system failures and environmental contamination. Wisconsin's progress continues to reflect very favorably with the US EPA.

Petroleum Environmental Cleanup Fund Act (PECFA)

The PECFA program from August 1989 through April 2002 has reimbursed petroleum storage tank system owners approximately \$1.15 billion to remediate petroleum contamination both in the soil and groundwater. The program, in addition to auditing owner invoices and authorizing payments, performs technical reviews of site investigations, remedial options, and grants closures for 65% of the State's LUST sites.

The budget bill passed in late August 2001 increased the bonding authority by \$72 million to a total of \$342 million. The proceeds from the sale of revenue bonds have been used to "pay down" the backlog of audited claims awaiting payment. The debt service that resulted from the original bond sales reduced the annual spending authority to \$75 million in FY 02 and \$68 million in FY 03. In FY 02, PECFA reimbursed close to 1,900 claimants a total of over \$115 million dollars. Currently PECFA is making reimbursement payments approximately 6 months after the claim is received. The petroleum inspection fee supports PECFA's spending authority.

The Department continues to use competitive bidding to establish a reimbursement cap for cleanup activities at contaminated sites. All sites which will cost the PECFA program more than \$60,000 must be competitively bid (exemptions available) through case closure. Competitive bidding allows environmental consulting firms to review the site investigation report and in compliance with the bid specifications, submit a cost through case closure. This bidding process establishes the lowest cost cleanup and a cost cap through case closure. Additionally, the site owners understand more clearly what remedial efforts are necessary to obtain closure. DNR and Commerce have completed the bidding process for 160 sites. The Department is currently reviewing existing sites that have been reimbursed >\$200,000. Early results indicate that many of these sites will be requesting closure, hereby halting the continued exhaustion of PECFA resources.

For more information, visit the following web site (<http://www.commerce.state.wi.us>) or contact Cathy Cliff, ERS Division Administrator, P. O. Box 7839, Madison, Wisconsin 53707-7839, phone: 608-266-9403, fax: 608-267-1381; e-mail ccliff@commerce.state.wi.us.

DEPARTMENT OF HEALTH AND FAMILY SERVICES

Chapter 160, Wis. Stats., directs the DHFS to recommend health-based enforcement standards for substances found in groundwater and specifies the protocol for developing the recommended standards. Recommended standards are sent to the DNR and are submitted through the rule-making process as amendments to ch. NR 140, Wis. Adm. Code. In the fall of 2001, DHFS staff completed work on recommendations for two additional groundwater enforcement standards and revisions of three existing enforcement standards. The proposed standards were approved for public hearing by the Natural Resources Board in June of 2002. After the hearings, the public comments received will be reviewed and responses prepared before final recommendations are made to the Board.

DHFS staff are the primary resource for information about the health risks posed by drinking water contaminants, and are charged with investigating suspected cases of water-borne illness. Toxicologists, public health educators, and epidemiologists employed in the Department's Division of Public Health present this information to the public at meetings and conferences, and provide direct assistance to Wisconsin families via home visits, letters to well owners, and telephone consultations. DHFS staff review correspondence sent to well owners by DNR representatives. The agency provides additional advice to owners of wells that are highly contaminated with volatile substances such as benzene and vinyl chloride, especially in cases where the contaminants may pose concerns from inhalation of indoor air. Follow-up letters sent by DHFS explain the health effects of the specific contaminant(s) and suggest strategies for reducing exposure until a safe water supply can be established. DHFS also prepares and distributes a wide variety of informational materials on groundwater and drinking water issues related to human health.

DHFS staff have been active in research and outreach activities relating to naturally-occurring arsenic in groundwater in Winnebago, Outagamie and Brown Counties. Long-term exposure to arsenic in drinking water has been shown to contribute to increased risk of skin, lung and bladder cancers, as well as a number of cardiovascular and dermatological problems. Other conditions that may be related to arsenic exposure include diabetes and adverse reproductive outcomes. DHFS staff received a grant from the GCC to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR and DHFS staff, town clerks and others have carried out township-based well sampling campaigns throughout Winnebago and Outagamie counties. More than 2200 families completed questionnaires aimed at assessing arsenic exposure and related health outcomes. Since the first round of sampling efforts, several townships have begun to conduct follow-up well testing campaigns on an annual basis, and some have expanded the scope of the sampling to include nitrate, bacteria and other contaminants of concern. Awareness of arsenic as a public health concern well water should continue to grow in northeastern Wisconsin as a result of these ongoing efforts.

In the summer of 2001, DHFS conducted a survey of households in selected areas of northeastern Wisconsin affected by arsenic in groundwater. The goal of this survey was to assess residents' understanding of their laboratory results, learn what actions people have taken in response to their results, and to identify barriers to increased participation in well sampling campaigns. The survey revealed that more than 80% of those who perceived their well water to be unsafe had taken action to reduce their exposure to arsenic, usually by installing a treatment system or by drinking bottled water. Among those who had not sampled their wells for arsenic, confidence in the safety of their well and lack of information about how to have their water tested were the most commonly cited reasons. Many of those who had not had their wells tested had reported that they had only recently moved into their homes or into the area.

Recent groundwater-related publications and presentations by DHFS staff:

Knobeloch, L.M., and M. Proctor. 2001. Eight blue babies. *Wisconsin Medical Journal* 100: 43-47.

Knobeloch, L.M., and H.A. Anderson. Arsenic-contaminated water and skin cancer in Wisconsin. Presentation given at the 5th International Conference on Arsenic Exposure and Health Effects, San Diego, CA, July 14-18, 2002.

For more information, visit the following web page (<http://www.dhfs.state.wi.us/eh/Water/index.htm>) or contact Henry Anderson (608-266-1253; anderha@dhfs.state.wi.us), Lynda Knobeloch (608-266-0923; knobel@dhfs.state.wi.us) or Mark Werner (608-266-7480; wernema@dhfs.state.wi.us), 1 W. Wilson St., Rm. 150, Madison, Wisconsin, 53701.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The Wisconsin Geological and Natural History Survey (WGNHS) performs basic and applied groundwater research and provides technical assistance, maps, and other information and education to aid in the management of groundwater resources. The WGNHS groundwater program is complemented by geology and soils programs that provide maps and research-based information essential to the understanding of groundwater recharge, occurrence, quality, and movement. WGNHS researchers collect and describe geologic samples from 250 wells per year.

In FY 02, the WGNHS continued to respond to requests for information and assistance from other local, state, and federal agencies, consultants, students, and the public. These requests ranged from the simple, "What will I find underground if I dig or drill here?" to more complex questions about groundwater flow, contaminant transport, or wellhead protection. Public information, records, and research results that the WGNHS stores and disseminates save the considerable expense of gathering the same geologic or groundwater information several times for different purposes, or "re-discovering" the same information over time.

Well Records and Statewide Well Network

Well records. The WGNHS serves as the repository for Well Constructor's Reports, one- to two-page reports that are usually submitted to the DNR by a well driller within a few years of a well's completion. In cooperation with the DNR, the WGNHS continues to review, sort, and catalog approximately 18,000 Well Constructor's Reports per year. Approximately 400,000 of these reports are on file at the Survey. The 1999 initiative to carry out computer scanning and basic database entry for all Well Constructor's Reports in the WGNHS files to support DNR's source-water assessment program has been completed.

The database and scanned images are now available to state agencies, consulting firms, and private well owners on CD-ROM. The computerization of these records will allow WGNHS to streamline our record keeping and provide better, more usable information to the public. Locational information of the Well Constructor's Reports is continually scrutinized and updated during our county and regional studies. The development of a separate statewide database for approximately 36,000 geologic logs and drillholes that have complete lithologic information will be continued.

Statewide groundwater level network. The statewide groundwater level monitoring network has been operated jointly with the USGS since 1946. Currently, the network consists of approximately 140 wells, in 66 counties. Over the past few years six shallow wells in the network have been replaced with wells of similar construction at the same locations because the original well screens were becoming plugged. The groundwater level monitoring network provides a consistent, long-term record of fluctuations in water levels in deep and shallow aquifers. Such information is critical for accurate analyses of the effects of high capacity wells pumping, the response of groundwater levels to droughts, and the effects of land-use changes on groundwater systems. The long-term data are also used for calibration of regional groundwater models.

In FY 03 the WGNHS, in cooperation with the USGS, will continue to compile and interpret data from the statewide network and will make the data available on the USGS web site at <http://wi.water.usgs.gov/gw/>. In addition, the WGNHS will continue to evaluate individual wells in the network for optimum data value at minimum cost. The WGNHS will continue to supply the information to public and private clients and aid in data interpretation.

County and Regional Groundwater Studies

County studies. Geologic and groundwater studies at the county scale continue to be an important part of WGNHS programs. During FY 02 the Survey carried out the following county-based groundwater studies:

Dane County:	Continued updates of the regional groundwater flow model; continued model simulations for local municipalities and industries; initiation of a two-year study on the effects of new rural subdivisions on groundwater; assistance with University-based research projects on springs and wetlands in the county.
Fond du Lac County:	Development (with D. Cherkauer, UW-Milwaukee) of a preliminary groundwater flow model of the county for use in the DNR source water assessment (SWAP) programs.
La Crosse County:	Preparation of a report on the hydrogeology of the county (scheduled for completion in FY 03); detailed studies of the hydrogeology beneath bedrock ridges in the county.
Sauk County:	Completion of depth to bedrock and water-table maps at 1:100,000 scale; completion of documentation for delineation of zones of contribution for municipal wells and presentation of project results at a series of public meetings in Sauk County as part of the SWAP program.

Rock County: Development of groundwater flow models for the SWAP program; delineation of contributing areas for municipal wells in the county.

Geologic and hydrogeologic analyses in southeastern Wisconsin. In the past several years, much public attention has been focused on the problem of ensuring an adequate and inexpensive supply of potable water to southeastern Wisconsin for the next century. The southeastern Wisconsin communities of Waukesha, Brookfield, Germantown, Menominee Falls, and Pewaukee, among others, are prohibited by the Great Lakes Charter from diverting water out of the Great Lakes Basin, which precludes them from drawing surface water from Lake Michigan. Water utilities in these areas are concerned that rapidly falling groundwater levels indicate that water supply will not be able to keep pace with development. In response to these concerns, the Southeastern Wisconsin Regional Planning Commission (SEWRPC) joined with the WGNHS and USGS to carry out a quantitative study of the deep aquifer system. This deep system, known as the sandstone aquifer, provides most of the water to the high-capacity wells serving municipalities in southeastern Wisconsin. Funding for much of this work was obtained from SEWRPC and participating water utilities.

During FY 02, the WGNHS, SEWRPC, and the USGS developed and calibrated a regional groundwater flow model for southeast Wisconsin. During FY 03 the project team will use the model to simulate various water management scenarios proposed by SEWRPC and the participating water utilities. The model will also be used to delineate zones of contribution to all municipal wells in the SEWRPC region with additional support from the DNR's SWAP program. During FY 03 the project team will prepare written reports on model development and management scenarios for the SEWRPC project.

One notable offshoot of the SEWRPC project has been the acquisition of new borehole geophysical data. Over the past few years, with DNR support, the WGNHS has significantly upgraded its geophysical logging capabilities and experience. During FY 02 the WGNHS worked with water utilities and their engineering consultants to collect new geophysical logs (temperature, gamma radiation, electrical properties, borehole flow, fluid properties, and water samples) from several deep (approximately 2,000 ft) municipal wells in southeast Wisconsin. These datasets are invaluable for improving the understanding of deep bedrock units and groundwater flow in the area. During FY 03 the Survey will continue to collect new geophysical logs from deep wells as they become available due to pump maintenance or other work.

Since 1999 the WGNHS, with DNR support, has carried out significant research on the hydrogeologic properties of the Maquoketa shale, the regional bedrock confining unit in southeastern Wisconsin. This unit controls downward movement of groundwater from the shallow aquifer to the deep sandstone aquifer and helps protect the sandstone aquifer from contamination. In FY 03 the Survey intends to prepare a publication summarizing this work. In late 2001 the WGNHS received a grant from the American Water Works Association Research Foundation (AWWARF) for additional study of bedrock aquitards. This project will be carried out cooperatively during FY 03 with Dr. John Cherry at the University of Waterloo (Ontario) and will focus on aquitards in Dane County and southeastern Wisconsin.

Groundwater Research Activities

Arsenic in Groundwater. The WGNHS, with DNR support, is carrying out research on the source(s) and geochemical characteristics of arsenic contamination in water-supply wells in northeastern and southeastern Wisconsin. In FY 02 the WGNHS completed field experiments in the Fox River Valley that evaluated mechanisms of arsenic release to groundwater from domestic wells completed in the St. Peter sandstone aquifer, including studies of arsenic exposure to residents in the area and the effects of well chlorination on arsenic levels. Results of this study were presented to DNR Drinking Water and Groundwater Program staff and used by the DNR to develop well construction guidelines for the Towns of Algoma and Omro. Results were also presented at several public meetings held in Winnebago County regarding the water supply for a proposed ethanol plant. The results of this research, conducted cooperatively with the USGS and with J. Antonio Simo of the UW-Madison Department of Geology and Geophysics, will be published in FY 03.

In FY 03, the WGNHS will begin a two-year study of sources and mechanisms of arsenic in groundwater in southeastern Wisconsin, emphasizing impacts to sand and gravel and shallow bedrock aquifers in Walworth County. This work has developed from a preliminary study of water quality in the area conducted by the WGNHS with DNR support in FY 01.

Groundwater recharge. Groundwater recharge is critical to maintaining the supply of Wisconsin's groundwater, but mapping and quantifying recharge areas and rates can be a difficult process. In cooperation with UW-Madison, the WGNHS has developed a computerized technique for rapidly delineating recharge areas for use in regional groundwater models. This method couples GIS techniques with basic landscape data and rainfall-runoff modeling and is being tested in Dane County.

Fluid flow in carbonate rocks. Carbonate rocks (limestone and dolomite) underlie much of Wisconsin and form important aquifers over large parts of the state. Groundwater in carbonate rocks can move through fractures and solution features. Groundwater velocities in such rocks can be unusually high, and the rocks usually have very low ability to attenuate contaminants. Consequently, carbonate rocks are very vulnerable to groundwater contamination. Predicting and monitoring groundwater flow in fractured carbonate rocks is challenging because these aquifers tend to develop two-component flow systems: rapid flow through small, discrete fractures and slower flow, but significant storage, in the matrix blocks. Work by the WGNHS on carbonate aquifers in eastern Wisconsin suggests that detailed stratigraphic analysis, coupled with geophysical and hydrogeologic data, may help predict the hydraulic properties of these complex and vulnerable aquifers.

Over the past few years, the WGNHS has developed a program of research and public education on groundwater movement in carbonate rocks and has provided assistance to various agencies facing carbonate-rock problems. Examples of recent work include verification of capture zones for municipal wells at Sturgeon Bay, investigation of groundwater under carbonate ridges in La Crosse County, and development of groundwater models for carbonate-rock areas in southeast Wisconsin. During FY 03 the WGNHS will continue these activities. WGNHS staff members are also involved in professional short courses on fractured-rock hydrogeology.

Karst features, including a variety of sinkholes, cavities, and solution openings, commonly are found in carbonate rock (limestone and dolomite). Environmental problems associated with karst features include rapid groundwater contamination, unpredictable groundwater flow, difficulty in groundwater monitoring, and unexpected failure or collapse of surface structures such as roads and foundations. In recent years there has been increased concern about the hazards and effects of karst features in many parts of Wisconsin, but little published information has been available. The WGNHS is serving as a clearinghouse for karst information, and has begun assembling a karst database for the state (<http://www.uwex.edu/wgnhs/karst.htm>).

During FY 03 the WGNHS will continue to provide data and consultation on karst issues as requested by various units of government and the public.

Crandon Mine. The WGNHS has also been actively assisting the DNR in its review of the proposed massive sulfide mine near Crandon, Wisconsin. This review includes development and testing of groundwater flow and contaminant transport models being used to evaluate the potential effects of the mine on local groundwater and surface-water features.

Research projects completed this year or in progress include:

1. Hydrogeology of Sauk County
2. Hydrogeology of Rock County
3. Hydrogeology of La Crosse County
4. Field verification of well capture zones for the City of Sturgeon Bay
5. Hydrogeologic properties of the Maquoketa shale
6. Hydrostratigraphy of southeast Wisconsin
7. Regional groundwater flow model of southeastern Wisconsin

8. Hydrogeology of Dane County
9. Investigation of arsenic contamination of groundwater in northeastern Wisconsin
10. Development of new methods for determining groundwater recharge rates
11. Review of material submitted regarding proposed mine near Crandon, Wisconsin
12. Investigation of the effects of rural subdivisions on groundwater quality.
13. Source-water protection for Fond du Lac County

Groundwater Education

WGNHS groundwater education programs for the general public are usually coordinated with the UW-Extension network of county-based faculty, the DNR, the Central Wisconsin Groundwater Center, or the UW-Extension Environmental Resources Center. The WGNHS also produces and serves as a distributor of many groundwater educational publications and visual aids. Some of these materials are primarily DNR products, but it has proven to be convenient and effective to use our map and publication sales and distribution system.

In October 2001 the WGNHS co-hosted the Midwest Groundwater Conference, a technical conference that drew participants from across the Midwest.

In FY 03 WGNHS staff members plan to participate in groundwater educational meetings in counties where county mapping and/or other hydrogeologic studies are in progress. Arsenic in groundwater and the potential groundwater implications of proposed quarries, gravel pits, and high-capacity wells have been popular topics recently and probably will continue to provide educational opportunities in FY 03. Staff members will also participate in about 20 other general groundwater educational programs throughout the state and teach hydrogeology at fairs and trade shows such as Farm Progress Days and the Water Well Association annual meeting. Several staff members will contribute to professional short courses that educate professionals (such as consultants, regulators, and officials) on technical aspects of well hydraulics, wellhead protection, waste disposal, etc. The WGNHS will also provide two staff members for eight days of instruction at the DNR-sponsored continuing education program for well drillers and pump installers. This is an annual event held at eight locations around the state.

Geologic and hydrogeologic field trips for DNR water staff and new DNR employees have been held in the past and will continue in FY 03. We also provide a collection of representative Wisconsin rocks for teachers to use, which include samples of our major aquifers.

For more information, contact Ken Bradbury, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Road, Madison, Wisconsin, 53705-5100; phone: 608-263-7389; email: krbradbu@facstaff.wisc.edu; web site: <http://www.uwex.edu/wgnhs/>

Recent WGNHS Publications

Miscellaneous Map 41: Depth to bedrock map of Trempealeau County, Wisconsin, 2001. K.J. Cates. (Scale 1:100,000.)

Miscellaneous Map 46: Depth to bedrock map of Buffalo County, Wisconsin, 2001. K.J. Cates. (Scale 1:100,000.)

Miscellaneous Map 52: Glacial landforms of the southern Green Bay Lobe, southeastern Wisconsin, 2002. P.M. Colgan. (Scale 1:100,000.)

Miscellaneous Map 53: Groundwater quality investigation maps of Buffalo County, Wisconsin, 2001. Compiled by P.D. Roffers and K.J. Cates. Plate 1: Nitrate as Nitrogen. Plate 2: Chloride. Plate 3: Laboratory measurement of alkalinity. Plate 4: Total hardness. Plate 5: Laboratory measurement of electrical conductivity. Plate 6: Ferrous iron. (Scale 1:100,000.)

Miscellaneous Map 54: Depth to bedrock map of Sauk County, Wisconsin, 2002. M.B. Gotkowitz and K.K. Zeiler. (Scale 1:100,000.)

Open-File Report 2000-02: Report on the preliminary investigation of arsenic in groundwater near Lake Geneva, Wisconsin, 2002. M.B. Gotkowitz, 24 p.

Open-File Report 2001-01: Field verification of capture zones for municipal wells at Sturgeon Bay, Wisconsin: Final report to the Wisconsin Department of Natural Resources, 2002. K.R. Bradbury, T.W. Rayne, and M.A. Muldoon, 30 p.

Open-File Report 2001-04: Verification and characterization of a fracture network within the Maquoketa shale confining unit, southeastern Wisconsin, 2001. T.T. Eaton, K.R. Bradbury, and H.F. Wang, 35 p.

Open-File Report 2002-02: Delineation of zones of contribution for municipal wells in Rock County, Wisconsin: Final report, 2002. S. Gaffield, M.B. Gotkowitz, and K.R. Bradbury, 48 p.

DEPARTMENT OF TRANSPORTATION

The DOT regulates the storage of highway salt (ss. 85.17 and 85.18, Wis. Stats.) to protect the waters of the state from harm due to contamination by dissolved chloride. DOT is also responsible for potable well sampling at 29 rest areas and 102 waysides. Other DOT groundwater related activities include: road salt research; hazardous material and waste investigation or remediation; wetland compensation and research; and storm water management and research. Various divisions and sections in DOT are responsible for these activities:

- Salt Use and Storage - Bureau of Highway Operations and District Highway Operations
- Salt Research - Bureau of Highway Construction (Geotechnical Section)
- Hazardous Materials (petroleum) - Bureau of Environment and District Environmental Coordinators
- Hazardous Waste - Division of Business Management (Risk & Safety Management Section)
- Wetlands - Bureau of Environment and District Environmental Coordinators
- Erosion Control and Storm Water Management - Bureau of Environment and District Environmental Coordinators.
- Potable Well Sampling - Bureau of Highway Operations

Salt Storage and Road Application. Highway salt is stored statewide by suppliers, counties, cities, villages, and private companies. Annual inspections occur and reports are provided for salt storage sites to insure that storage practices are in accordance with ch. Trans 277, Wis. Adm. Code (Highway Salt Storage Requirements). The intent of the Code is to help prevent entry of highway salts into waters of the state from storage facilities. All salt must be covered and stored on an impermeable base. The base for stockpiles is required to function as a holding basin and to prevent runoff. The covers must consist of impermeable materials or structures to prevent contact with precipitation. State funded facilities are being added to the DOT salt storage program to provide more indoor storage. This will improve groundwater protection and it creates greater flexibility for scheduling salt purchase at optimal prices.

Current policy in the State Highway Maintenance Manual restricts the spreading of deicer salts to a maximum of 400 pounds per lane mile per initial application, and 300 pounds per lane mile for subsequent applications. Electronic controls for salt spreader trucks are continually tested to record and verify application rates and coverage effectiveness. New technology equipment (e.g., zero-velocity spreaders, ground speed controllers, and onboard liquid pre-wetting units) has been installed on county highway patrol trucks to help keep a greater percent of salt applied to the roadway on the pavement surface. Additional efforts to minimize and conserve salt applications are being pursued by use of an in situ weather monitoring system. This system consists of temperature sensors and remote processing units, which determine and record temperatures of road pavements at 56 separate locations along

major highway routes. The pavement temperature information helps determine the sand and salt application rates. Annual training for proper snowplowing and salt spreading techniques is provided for county snowplow operators, and the counties provide weekly reports of salt usage.

During the 1997-98 winter season several counties began using alternative anti-icing and deicing chemicals on test sections in an effort to reduce the amount of chlorides applied to pavement and impacts on groundwater. Use of pro-active anti-icing techniques should result in lower chemical usage and reduce total winter maintenance costs.

During the 2001-02 winter season: salt use on the state trunk highway system was approximately 309,000 tons, the lowest use since 1994-95 (295,000 tons); 30 counties used liquid $MgCl_2$ products for pre-wetting or anti-icing applications; 8 counties used one of the agricultural based products either for pre-wetting or anti-icing applications; and 29 counties used salt brine for pre-wetting or anti-icing.

Salt Research - Since 1970, DOT has investigated potential road salt impacts on the environment adjacent to highways. Early investigations (1970s to early 80s) were focused on evaluating road salt impacts to surface water runoff, vegetation, and soils. In the last several years DOT has conducted limited investigations evaluating road salt impacts to groundwater (1 or 2 shallow monitoring wells per site). To date approximately 20 sites throughout the state have been studied. In general, each site is monitored quarterly for a period of 5 years. The monitoring consists of analyzing soil, water, or vegetation samples for calcium, sodium, chloride, and electrical conductivity. Approximately 5 sites are currently monitored, and future groundwater monitoring plans are being evaluated (i.e., longer monitoring periods and multiple well arrangements per site). Results from the studies are discussed in 5 separate DOT progress reports entitled: Investigation of Road Salt Content of Soil, Water and Vegetation Adjacent to Highways in Wisconsin (1972, 1975, 1979, 1989 and 1996). The next progress report is due in 2002.

Hazardous Materials (Petroleum) and Hazardous Waste - As part of the highway improvement program, DOT performs an estimated 25 to 75 environmental assessments annually along right-of-way where potential sources of petroleum or hazardous waste contamination may occur. Assessments consist of standard environmental audits of properties, environmental drilling, and sampling to identify or delineate the extent of soil or groundwater contamination. Numerous contaminated sites are identified as part of the environmental assessment process. This information is shared with DNR so appropriate enforcement and remedial action is taken to protect groundwater resources. In addition, DOT works with DNR and Commerce on 15 to 25 sites per year where underground storage tank removal or other remedial actions are necessary to accomplish highway improvement (e.g., managing the removal, treatment, and disposal of contaminated soils or groundwater). DOT manages about 7,500 to 15,000 tons of contaminated soil per year and about 5 million gallons of contaminated water per year.

Wetlands - Compensatory wetland mitigation is required under section 404 of the Clean Water Act for transportation projects. DOT completed a cooperative study with the US Geological Survey on groundwater of three wetland compensation projects. The final report on this study, *Hydrogeological, Geomorphological, and Vegetative Investigations of Select Wetland Creation and Restoration*, was completed February 1999, and is available. DOT has several ongoing wetland monitoring projects, which evaluate wetland hydrology, water quality and biotic response to constructed mitigation sites.

Since July 1993, DOT has an interagency approved wetland mitigation banking program. In March 2002 the second revision of *Wisconsin DOT Wetland Mitigation Banking Technical Guideline* was agreed upon by the regulatory agencies. This revision allows in addition to wetland restoration and creation the use of preservation for wetland protection, enhancement of existing wetlands and upland buffer to restored or created wetland. Currently wetland loss due to highway, bridge and airport may be compensated through the bank system. As of December 31, 2000, there have been 1,719 wetland acres lost to 958 DOT construction projects throughout the state since 1990. This loss was compensated by 2,434 acres of wetland restoration and creation. Thirty wetland bank sites have been planned and constructed. There are 15 constructed bank sites containing 1,386 available wetland acres. The percent acres compensated through the bank is approximately 60%, while remaining compensation is done on or near specific transportation projects. During calendar year 2001 there were 212 construction projects that caused

394.45 acres of wetland loss, which compensated at bank sites (300.83 ac.), on-site (75.7 ac.) or near-site (114.8 ac.).

Erosion Control and Storm Water Management - DOT has established erosion control standards for airport, railroad, and highway construction projects as well as maintenance projects administered by DOT. These standards were created to minimize on-site erosion damage and to minimize adverse impacts to waters of the state resulting from sediment or pollutant accumulation. Construction projects must adhere to best management practices, performance standards, and erosion control implementation as stated in ch. Trans. 401, Wis. Adm. Code. Best management practices, given in Chapter 10 of DOT's Facilities Development Manual, include devices and procedures employed to minimize erosion. Best management practices were developed in consultation with the DNR, Federal Highway Administration (FHWA) and the road building industry.

Chapter 10 of the Facilities Development Manual has been revised to include management of storm water runoff from transportation facilities. The revised Manual contains interim storm-water management policy. Currently, storm-water best management practices are being incorporated into projects on a case-by-case basis.

Other Groundwater-Related Research and Projects - DOT is currently participating in a FHWA study investigating methods for treatment of highway runoff which flows directly into karst sinkholes for the purpose of protecting groundwater resources. Another effort to improve water quality from highway runoff includes a research project to evaluate the effectiveness of high efficiency street sweepers for pollutant reduction and participating in a study to verify the effectiveness of various storm water treatment devices.

For more information, visit the following web site (<http://www.dot.state.wi.us>) or contact Ms. Carol Cutshall, Director, Bureau of Environment, Room 451, P. O. Box 7965, Madison, Wisconsin 53707-7965; phone: 608-266-9626, or e-mail carol.cutshall@dot.state.wi.us.

UNIVERSITY OF WISCONSIN SYSTEM

The UWS has research, teaching and outreach responsibilities. These three missions are integrated through cooperation and joint appointments of teaching, research, and extension personnel who work on groundwater issues. In cooperation with other state and federal agencies, groups and individuals, innovative problem-solving approaches to groundwater resource issues are provided to the State's citizens through research, publications, meetings, teleconferences, satellite programs, water testing, and other forms of assistance. Activities of several specific programs follow.

The UW Water Resources Institute (WRI)

The UW Water Resources Institute (WRI) is one of 54 water resources institutes located at land grant universities across the nation. It promotes research, training, and information dissemination focused on the nation's water resources problems. The WRI research portfolio includes interdisciplinary projects in four broad areas: groundwater, surface water, groundwater-surface water interactions, and drinking water. Groundwater is a top priority and an area of particular strength at the Wisconsin WRI. Key areas of emphasis in 2002 included studies of the behavior of mercury in the aquatic environment and investigations into the presence of arsenic in drinking water supplies.

Research. During FY 02 the WRI directed a wide-ranging program of priority groundwater research consisting of 14 projects. The projects included short- and long-term studies, and may be of a fundamental or applied nature. They provide a balanced program of laboratory, field and computer-modeling studies and applications aimed at preserving or improving groundwater quality. The groundwater problems that were investigated include:

- Determination of the importance of groundwater in the production and transport of methyl mercury in Lake Superior tributaries;

- Investigation of denitrification as a basin-scale control of nitrate concentration and export in Wisconsin aquifers;
- Characterization of the hydrologic system in the Driftless Area of Wisconsin, by improving estimates of recharge, hydraulic conductivity, and aquifer storage;
- Examination of groundwater-lake interactions by estimating transient water-level response in lakes and the surrounding aquifer to potential climate change;
- Examination of the influence of groundwater on summer water temperatures in trout streams;
- Identification of ecologically important (adverse) effects of insecticide-polluted groundwater in a sensitive, efficient, cost-effective invertebrate whole animal assay.
- Testing the use of “rain gardens” for receiving runoff and recharging local aquifers;
- Examination of how subdivisions constructed without private sewers may contaminate groundwater;
- Development of thin-film microporous absorbents to remove arsenic from contaminated groundwater;
- Investigation into the use of alfalfa for bioremediation of nutrients in groundwater;
- Investigation into the feasibility of removing heavy metals from contaminated soils using cationic surfactant;
- Development of an efficient and economical method of removing arsenic from groundwater with minimal waste byproducts;
- Examination of methods of removing iron from groundwater and assessing the potential for using these methods to simultaneously remove arsenic;
- Determination of whether stream water can serve as an indicator of groundwater quantity.

The 14 funded projects provided training in several disciplines for post-doctoral research associates, graduate student research assistants and undergraduate students at UW-Madison, UW-Milwaukee, UW-Stevens Point and UW-Parkside.

The UWS selected six new groundwater research projects from this year’s Joint Solicitation for support during FY 03 (July 1, 2002 – June 30, 2003) (see Table 2). Seven projects, selected from the previous year Joint Solicitation, will receive continuation support during FY 03. New projects are based at UW-Madison, UW-Extension, UW-Stevens Point and UW-Whitewater.

Teaching. Institutions within the UWS continue to offer undergraduate- and graduate-level courses and programs focusing on diverse issues regarding groundwater resources. Additionally, several campuses offer for-credit, field-oriented water curriculum courses for middle and high school teachers during summer sessions. The WRI views education as an important component of its total program, and recognizes the importance of K-12 education as a fundamental component of its outreach and training effort. The WRI distributes two publications—*Local Watershed Problem Studies-Elementary Activities* and *Local Watershed Problem Studies-Middle and High School Curricula Guide*—upon request. These two guides assist educators in the development and dissemination of curricula concerning soil and water resources. In addition, the Water Resources Library has purchased a number of other guides with innovative approaches to teaching water-related science in K-12 classes.

Grants Administration. WRI staff members have developed a web page that enables online proposal submission and review of the FY 03 Joint Solicitation of Groundwater and Related Research and Monitoring Proposals. The site allows investigators to submit proposals one section at a time, rather than waiting until the entire document is complete. Having proposals in electronic format also makes the proposal review process more convenient. Reviewers can simply log on to the site and review proposals at their convenience.

Information Transfer. Results of WRI-supported research are published in a variety of formats. Most WRI research ultimately appears in refereed professional journals, although results are also published in technical reports, conference proceedings and abstracts, book chapters, dissertations and theses, and conference presentations. In addition, WRI disseminates groundwater research results to a wider audience through its web site at <http://www.wri.wisc.edu/>. Staff members maintain a complete list of publications resulting from UWS-funded projects at <http://www.wri.wisc.edu/Publications/66-00pubs.html>. The Water Resources Library makes copies of the publications available to the public.

WRI also assists in disseminating information about DNR, DATCP and Commerce projects funded through the Joint Solicitation. WRI established and continues to maintain the Wisconsin Groundwater Research and Monitoring Project web page at <http://www.wri.wisc.edu/wgrmp/wgrmp.htm>. This site presents summaries of the results of more than 100 completed groundwater research/monitoring projects funded through the Joint Solicitation since 1989, and is updated as projects are completed. The Water Resources Library lends copies of the complete final project reports to the public.

WRI staff has begun redesigning the Groundwater Research and Monitoring Project web page to make it easier to use and more visually appealing. Plans for the redesign include an expanded search capability and the availability of complete final reports in pdf format. Use of the site grew almost 100% from FY 01 to FY 02. Site improvements should make it even more popular and effective in disseminating groundwater-related research results.

The Online Directory of Water Expertise and the Water Resources Library offer other avenues for the dissemination of groundwater-related research information. First put online in 2000, the database contains more than 800 water experts, including groundwater professionals, and can be searched by area of expertise, research interests or name. The database can be found at <http://www.wri.wisc.edu/wriexpertise/index.asp>. Users with an interest in water issues can contact the experts by phone, fax or email. Water professionals can sign up or update their entries online. In June 2002, WRI began a comprehensive update of the database.

Water Resources Library. The Water Resources Library maintains a specialized collection of more than 25,000 water-related publications, 30 journals and 100 newsletters. The collection covers all major topics in water resources, but is particularly strong in groundwater-related publications. A popular service is the K-12 water-related curricula collection. All materials are included in MadCat, the UW-Madison online library catalog, and can be searched at <http://madcat.library.wisc.edu>. The library will assist and lend materials to anyone with an interest in water.

Because the library is located on the UW-Madison campus, the library collection is supplemented by the university's major research collection, numerous online databases and full-text resources. The Water Resources Library also maintains a web site (<http://wri.wisc.edu/library>), which serves as a gateway to water-related information on the Web as well as a guide to the library. Web users can pose questions to AskWater, the library's online reference service. The library's monthly publication, "Recent Acquisitions and Web Sites of Interest," frequently emphasizes groundwater-related publications and web sites, and is distributed widely among university personnel, state agency staff, researchers, consultants, libraries, private organizations and interested citizens.

Media Relations. The institute has a media relations professional on staff, who regularly distributes news releases, media advisories and other information regarding groundwater-related research. A news release sent out in March 2002, regarding new groundwater projects, solicited the interest of several media outlets across the state, most

notably WXPB in Rhinelander, which aired an interview with Institute Director for Research James Hurley. Most recently, the WRI issued a news release on new projects funded in July 2002.

Conferences, Meetings, and Presentations. The Wisconsin WRI co-sponsored the American Water Resources Association—Wisconsin Section annual meeting on March 7 and 8, 2002, in Wisconsin Dells, Wisconsin. The title of this year's event was "Sustainability of Wisconsin's Water Resources." Conference speakers explored the threats to water supply and quality resulting from increased urbanization, agricultural expansion, climate change, and population growth. More than 35 contributed papers or posters, covering a range of topics regarding Wisconsin's water resources, were presented. The meeting is unique, in that it especially encourages students to present papers or posters describing their original research. Students funded by the Joint Solicitation are asked to present results of their research at this forum.

The institute also was a co-sponsor of the 46th Annual Midwest Groundwater Conference, which was held in Madison in October 2001. The conference focused on the political and scientific implications of current groundwater issues in Wisconsin, and featured more than 60 contributed papers and posters addressing water resources issues in the Midwest.

For more information, visit the following web site (<http://www.wri.wisc.edu/>) or contact Dr. Anders W. Andren, Director, UW-Madison Water Resources Institute, 1975 Willow Drive, Madison, WI 53706; phone (608) 262-0905, Fax (608) 263-2063, or email awandren@seagrant.wisc.edu.

UW-Extension Water Programs

Central Wisconsin Groundwater Center. The Central Wisconsin Groundwater Center provides groundwater education and technical assistance to the citizens and governments of Wisconsin. Programs range in breadth from answering citizen questions to helping communities with wellhead protection planning, describing the extent and causes of groundwater nonpoint pollution in Wisconsin, and examining groundwater quantity issues. The Center is an office of UW-Extension located at UW-Stevens Point, and frequently works through county Extension faculty in program delivery. More information can be found at the Center's web site: <http://www.uwsp.edu/cnr/gndwater/>.

In 2001, the Center assisted nearly 2800 households in having their water tested in conjunction with county Extension offices and the UW - Stevens Point Environmental Task Force Program. Of these, 11% exceeded drinking water standards for nitrate-nitrogen. Eighteen percent were unsafe because of coliform bacteria. Twelve education programs helped nearly 800 well users in 8 counties understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

Center staff are playing pivotal roles in a number of state groundwater issues. This includes working with stakeholders on groundwater extraction policy and law, and lending leadership to the Wisconsin Academy's Waters of Wisconsin effort. Center staff are also involved with agencies and private organizations, including the Wisconsin Potato and Vegetable Growers Association Nonpoint Pollution subgroup; DATCP Atrazine Technical Advisory Committee; Golden Sands Resource Conservation and Development Area Water Resources Committee; and Extension Nutrient Management Self-Directed Team. Involvement with local watershed based groups includes the Wolf River Basin Partnership and Pigeon River Partnership. The Center has also provided technical assistance to the Portage County Citizens Groundwater Advisory Committee and its subcommittees.

A new effort this year involves using the national Groundwater Guardian program to build the groundwater knowledge and leadership skills of Wisconsin citizens in order to develop a Wisconsin grass-roots groundwater constituency. In partnership with the DNR, the Center has hired a statewide Groundwater Guardian program coordinator. The program has developed outreach materials including a display, presentation, and brochure; made numerous presentations to interested groups; and assisted the seven existing Wisconsin Groundwater Guardian communities in carrying out their activities. More about the Wisconsin Groundwater Guardian program can be found on the web site: (<http://www.uwsp.edu/cnr/gwguardian>).

UWS Farm and Home Environmental Management Program. The UWS Farm and Home Environmental Management Program encompasses voluntary pollution risk assessment and prevention activities, including the Farm Assessment System (Farm*A*Syst) and Home Assessment System (Home*A*Syst) programs. The “Farm and Home” program enables urban and rural landowners, managers and residents to assess environmental and health risks and to take voluntary actions to prevent pollution. Farm*A*Syst and Home*A*Syst provide fact sheets and worksheets that help farmers and other land managers assess water pollution risks related to their structures, management practices, and site characteristics. The programs are available statewide.

An impact assessment study estimated that concerned citizens nationwide completed at least 46,000 pollution risk assessment worksheets in 1999-2000, and invested at least \$17.5 million to fix problems and prevent pollution. A successful project in Grant County, Wisconsin, has led the County Land & Water Conservation Committee to continue a staff position after grant funds ran out. A follow up survey to participants in the original USDA Environmental Quality Incentives Program (EQIP) project in Grant County found more than one quarter of respondents had invested already in changes linked directly to their Farm*A*Syst experience, and nearly all others listed changes they still intended to make. Ninety percent said they found the program valuable and would recommend it to a neighbor.

The Wisconsin Dairy Environmental Management System builds on the Farm*A*Syst foundation and provides an opportunity for creative response to the forthcoming EPA regulations on Concentrated Animal Feeding Operations. Collaborators in shaping the Wisconsin program include the Wisconsin Dairy Business Association, the Wisconsin Milk Marketing Board, and the Professional Dairy Producers of Wisconsin, as well as DATCP, DNR, and the UWS Nutrient and Pest Management program. A \$2,500,000 grant from USDA, led and administered by the “Farm and Home” program, is supporting similar pilot projects with dairy, beef and poultry producers in 8 states besides Wisconsin. The Healthy Homes Partnership, an offshoot of Home*A*Syst, has just published its new edition of *Help Yourself to a Healthy Home* – for use in Wisconsin and nationwide. The booklet is a self-help informational workbook that focuses on children’s environmental health, with some attention to actions that protect water quality.

2001 and 2002 Publications:

Reducing Food Safety Risks in Apples. (20-page booklet with background information and risk assessment worksheets.) Co-authored by Richard Castelnuevo of the National Farm*A*Syst/Home*A*Syst Office, and Steven Ingham, University of Wisconsin Madison, Food Science Department.

Pesticide and Nutrient Management for Orchards (12-page factsheet/worksheet) and *Seasonal Integrated Pest Management Checklist for Orchards* (8-page worksheet). In conjunction with the National Farm*A*Syst office, co-authored by Charles Edson, Allen Krizek, Roberta Dow, David Epstein, Larry Gut, Amy Irish-Brown, Gary Thornton and Don Lehman of Michigan State University, with private crop consultants Doug Murray and John Bakker.

*Farm*A*Syst/Home*A*Syst Program Impacts Update, Focus: 1999-2000* (40-page booklet). Co-authored by David Eagan with Farm*A*Syst/Home*A*Syst staff.

Environmental Management Systems for Agriculture: Improving Your Environmental and Economic Bottom Line. 12 minute Video. UW Extension.

Help Yourself to a Healthy Home. Protect Your Children’s Health. 2nd Edition. Healthy Homes Partnership.

UW Environmental Resources Center (ERC). The UW Environmental Resources Center (ERC) develops and coordinates a number of national youth water education initiatives related to groundwater. It provides a database of more than 140 youth water-related curricula that may be searched by grade level or water topic. The ERC continues to provide national coordination for a service-learning curriculum, *Give Water a Hand*. The goals of this curriculum are to protect and improve local water quality by encouraging youth to investigate local issues, and plan

and complete a service project to address a problem they identify with the assistance of a local natural resource expert. Program materials consist of an Action Guide for youth, with step-by-step instructions for addressing local watershed concerns, and a Leader Guidebook to assist teachers and youth leaders in facilitating projects. Both guides may be downloaded from the *Give Water a Hand* web site, <http://www.uwex.edu/erc/gwah>. Other ERC youth water education initiatives include: *Agua Pura*, a leader institute planning manual and guide for Latino water education; an evaluation of USGS water education materials to assist with USGS education program development decisions; and gap analyses of youth water curriculum for source water education and riparian education resources. New water education projects include the development of a national riparian curriculum and a collaboration with USDA/CSREES and other federal agency clean and safe water partners to develop and promote best education practices for water education and to improve access to education resources and strategies. Many of these items are posted on the ERC web site at <http://www.uwex.edu/erc>.

UW Nutrient and Pest Management (NPM) program. The UW Nutrient and Pest Management (NPM) program mainly serves Wisconsin farmers and the other agricultural professionals who assist them in making management decisions. A prime focus of NPM programs is to improve nutrient management practices to save money and reduce the potential for nonpoint source pollution. The program's regional staff works one-on-one with farmers in priority watersheds or other critical areas. For instance, NPM is working on a farmer centered environmental assessment and assistance system for St. Croix county dairy producers. The purpose is to encourage the adoption of agricultural practices that protect the farm's water resources. NPM is also part of a team helping create and environmental management system for Wisconsin dairying.

The NPM program revised and distributed the Nutrient Management Farmer Education Program Curriculum that was taught in 16 counties in winter and/or spring of 2000/2001. It continues to lead educational and organizational efforts with Wisconsin's custom manure haulers. These businesses handle manure for hire (almost one third of the dairy manure generated in state) and are crucial for implementing nutrient management plans on many acres. NPM provided leadership and support to start their new professional organization started this year.

A parallel NPM focus is increasing educational programs on integrated pest management to assist farmers moving beyond pesticide-dependent cropping systems. Activities include hands-on IPM training for farmers, publications, and field research and demonstration projects. More information on these efforts and many publications are available at the NPM web site (<http://ipcm.wisc.edu>).

Basin Education Program. The UWS cooperates with other state agencies involved with water resources and natural resource issues. In 1998, UW-Extension entered into a new partnership with the DNR and USDA-NRCS in Wisconsin. This new partnership provides land and water resources education in the state's 22 major river basins. Fifteen Basin Educators work collaboratively with three publication/editorial specialists, two evaluation experts, and one coordinator who works on volunteer-based issues. Collectively this river basin focus works to support other local conservation professionals such as county Extension agents, Land Conservation Department staff, and NRCS staff. This focus on river basins includes drinking water fact sheets, newsletter articles about groundwater, and in some instances, specific watershed studies that address unique water quality problems. More information can be found at <http://clean-water.uwex.edu/index.html>.

Multi-Agency Land and Water Education Grant Program (MALWEG). UW-Extension also coordinates the Multi-Agency Land and Water Education Grant Program (MALWEG) which has funded ten groundwater-focused projects since its inception in 1997. These projects, which totaled over \$170,000 in educational assistance funds, examined the effects of intensive rotational grazing on groundwater quality, provided well testing for rural landowners, and conducted Farm*A*Syst assessments to help farmers identify and address groundwater contamination on their property. Altogether, between January 1, 1997, and December 31, 2001, 106 projects totaling over \$1.4 million have been funded to improve Wisconsin's land and water resources. The source of this money has primarily been the USDA's Environmental Quality Incentives Program. More information can be found at <http://clean-water.uwex.edu/malweg/index.htm>.

For more information on UW Extension groundwater programs, contact Jim Peterson, UW Environmental Resources Center, 1450 Linden Drive, Madison, WI 53706-1562, phone (608) 262-3799, fax (608) 262-2031, or email jopeters@facstaff.wisc.edu, or Chris Mechenich, Central Wisconsin Groundwater Center, College of Natural Resources, UW-Stevens Point, Stevens Point, WI 54481; phone (715) 346-4270; email gndwater@uwsp.edu.

Wisconsin State Laboratory of Hygiene

At the Wisconsin State Laboratory of Hygiene (WSLH), a great deal of effort is focused on identifying and monitoring chemical and microbial contaminants in groundwater, both through routine testing, specialized research, emergency response, and education and outreach. The testing and research related to groundwater spans several departments at WSLH and, collectively, their efforts make up the WSLH Drinking Water Quality Program. The mission of the WSLH Drinking Water Quality Program is to protect the health of drinking water consumers by providing analytical expertise, research and educational services to the scientific and regulatory communities.

The chemical and microbial groundwater contaminants tested include all contaminants regulated by the federal Safe Drinking Water Act as well as many emerging contaminants that appear on the USEPA Contaminant Candidate List. Examples include: fecal indicators (Total coliform, *E. coli*, Coliphage), *Helicobacter pylori*, *E. coli* O157:H7, *Salmonella*, waterborne viruses, parasites (*Cryptosporidium*, *Giardia*, and microsporidia), radioactivity, inorganic compounds (mercury, nitrate, arsenic) and organic compounds (atrazine, PCBs, PBDEs).

The state and nationally funded research projects conducted by the Drinking Water Quality program at WSLH focus on a variety of topics related to analysis and monitoring of microbiological and chemical contaminants in groundwater. Examples of research projects started or ongoing in FY02 include:

- Development of a culture methods for detection of *Helicobacter pylori* in ground water (WDNR);
- Preservation and survival of *E. coli* in well water samples submitted for routine analyses (WDNR and US EPA);
- Assessment of source waters and drinking waters for estrogenic endocrine disrupters (AWWARF);
- Well chlorination in arsenic-sensitive areas (WDNR);
- Assessment of the ability of mound sand (ASTM C33) to remove microorganisms in column experiments (WDNR and Commerce);
- Virus groundwater surveillance studies (USGS);
- Analysis of secondary metabolites of atrazine using ELISA (WDNR).

Another important focus of the WSLH Drinking Water Quality Program is emergency response to incidences involving groundwater. For example, WSLH works with DHFS and DNR in outbreak investigations of unknown (possibly food or water) origin and provides consultation services during outbreaks, both for local public health officials, local media, and the general public. WSLH also responds to spills and incidents and supports state agencies in remediation and emergency clean-up activities. Most recently, WSLH has focused its efforts on enhancing and expanding terrorism response programs.

WSLH also provides educational and outreach activities related to groundwater and drinking water. Examples include: providing instructional consultations for well owners and well drillers; on-site training of municipal water supply operators; tours for a variety of international, educational, regulatory, and other governmental groups; development of an interactive study guide dealing with safety, sampling, and chemistry for drinking water operators; and attendance, presentations, and paper submissions for a variety of conferences and symposia, and publications related to drinking water.

For more information, contact William Sonzogni, Wisconsin State Laboratory of Hygiene, 2601 Agriculture Drive, Madison, WI 53703, phone (608) 224-6200, or email sonzogni@facstaff.wisc.edu.

UWS Publications and Presentations Resulting from Joint Solicitation-Funded Research in FY 02

- Alessi, D.S. and Z. Li. 2001. Synergistic effect of cationic surfactants on perchloroethylene degradation by zero-valent iron. *Environ. Sci. & Technol.*, in press.
- Allran, J.W. and W.H. Karasov. 2001. Effects of atrazine on embryos, larvae, and adults of anuran amphibians. *Environ. Toxicol. Chem.* 20: 769-775.
- Armstrong, D.E. and R.J. Noll. 2001. On-line SFE/GC for improved detection of trace organic pollutants in ground water monitoring. Groundwater Research Report WRI GRR 01-04. Madison: UW Water Resources Institute.
- Bahr, J.M. and L. Parent. 2002. An Improved Hydrogeologic Model for the Token Creek Watershed. Final report to DNR.
- Benson, C.H. and T. Lee. 2002. Using Waste Foundry Sands as Reactive Media in Permeable Reactive Barriers. Final report to DNR.
- Bravo, H.R. 2001. Groundwater flow and heat transport in wetlands : transient simulations and frequency-domain analysis. Groundwater Research Report WRI GRR 01-02. Madison: UW Water Resources Institute.
- Bravo, H.R., F. Jiang and R.J. Hunt. 2001. Using groundwater temperature data to constrain parameter estimation in a groundwater flow model of a wetland system, submitted to *Water Resources Research*.
- Bravo, H.R., F. Jiang and R.J. Hunt. 2001. Parameter estimation for a groundwater flow and heat transport model of a wetland system: Selection of time scales through frequency domain analysis, submitted to XXIX IAHR Congress, Beijing, China.
- Brye, K.R., J.M. Norman, L.G. Bundy, and S.T. Gower. 2001. Nitrogen and carbon leaching in agroecosystems and their role in denitrification potential. *J. Environ. Qual.* 30:58-70.
- Collins, M.L.P. and C.C. Remsen. 2001. Monitoring : evaluation of the abundance, diversity, and activity of methanotroph populations in groundwater, July 1998 - June 2000. Groundwater Research Report WRI GRR 01-03. Madison: UW Water Resources Institute.
- Connelly, J., D. Dinsmore, T. Hegeman, B. Shaw, R. Stephens, N. Turyk, and J. Schultz. 2002. Evaluating options for changing groundwater monitoring requirements for landfills to reduce mercury used by laboratories.
- Dripps, W.R. 2002. The Spatial and temporal variability of natural groundwater recharge. Ph.D. Thesis. Department of Geology and Geophysics, University of Wisconsin – Madison.
- Dripps, W.R., M.P. Anderson, and K.W. Potter. 2001. Temporal and spatial variability of natural groundwater recharge. Groundwater Research Report WRI GRR 01-07. Madison: UW Water Resources Institute.
- Dripps, W.R., C.J. Kucharik, J.D. Lenters, M. P. Anderson and J.A. Foley. 2001. Modeling the spatial and temporal distribution of groundwater recharge across a forested watershed in northern Wisconsin. Abstract. American Geophysical Union, 2001 Spring Meeting, Boston, MA, Eos, Vol. 82.
- Dripps, W.R., M.P. Anderson, and R.J. Hunt. 2001. Use of a coupled heat and water transport model (VS2DH) for estimating rates of natural groundwater recharge. Abstract. American Water Resources Association – Wisconsin Section, 25th Annual Meeting, Green Lake, WI, p. 27.
- Dripps, W.R., M.P. Anderson, and R.J. Hunt. 2001. The use of temperature profiles through unsaturated soils to estimate short-term rates of natural groundwater recharge. Abstract. American Geophysical Union, 2001 Spring Meeting, Boston, MA, Eos, Vol. 82.

- Eaton, T.T. 2002. Fracture heterogeneity and hydrogeology of the Maquoketa aquitard, southeastern Wisconsin. Unpublished Ph.D. dissertation. Department of Geology and Geophysics, University of Wisconsin-Madison.
- Eaton, T.T. 2001. Hydraulic conductivity and specific storage of the Maquoketa shale. Groundwater Research Report WRI GRR 01-01. Madison : UW Water Resources Institute.
- Eaton, T.T, K.R. Bradbury, and H.F. Wang. 2002. Verification and Characterization of a Fracture Network within the Maquoketa Shale Confining Unit, Southeastern Wisconsin. Final report to DNR.
- Edil, T.B. and C.H. Benson. 2001. Compatibility of Containment Systems with Mine Waste Liquids. Groundwater Research Report WRI GRR 01-09. Madison: UW Water Resources Institute.
- Jansen, J. 2001. Time domain electromagnetic induction survey of eastern Waukesha county and selected locations. Groundwater Research Report WRI GRR 01-05. Madison: UW Water Resources Institute.
- Li, Z. 2001. Admicelle-catalyzed reductive dechlorination of perchloroethylene (PCE) by zero valent iron: project completion report. Groundwater Research Report WRI GRR 001-06. Madison: UW Water Resources Institute.
- Li, L., G.R. Eykholt and C.H. Benson. 2001. Groundwater Modeling: Semi-Analytical Approaches for Heterogeneity and Reaction Networks. Groundwater Research Report WRI GRR 01-10. Madison: UW Water Resources Institute.
- Lin, H.S. and S. Wang. 2001. Artificial neural network for nonpoint source pollution assessment in watersheds. In the Proceedings of the 5th International Conference on Diffuse/Nonpoint Pollution and Watershed Management, June 10-15, 2001, Milwaukee, WI.
- Lott, R.B. and Hunt, R.J. 2001. Estimating evapotranspiration in natural and constructed wetlands. *Wetlands* 21: 614-628.
- Norman, J.M. and K.R. Brye. 2001. Field Monitoring of Drainage and Nitrate Leaching from Managed and Unmanaged Ecosystems. Groundwater Research Report WRI GRR 01-08. Madison: UW Water Resources Institute.
- Peterson, J.K., D.R. Kashian, and S.I. Dodson. 2001. Methoprene and 20-OH-Ecdysone affect male production in *Daphnia pulex*. *Environ. Toxicol. Chem.* 20: 582-588.
- Schreiber, M.E. and J.M. Bahr. 2002. Nitrate-enhanced bioremediation of BTEX-contaminated groundwater: parameter estimation from natural-gradient tracer experiments. *J. Contam. Hydrol.* 55: 29-56.
- Schreiber, M.E., M.D. Zwolinski, P.J. Taglia, J.M. Bahr, and W.J. Hickey. 2001. Microbiological and hydrogeochemical controls on anaerobic biodegradations of petroleum hydrocarbons, Case study from Fort McCoy, WI, EOS, AGU Spring Meeting.
- Stites, W. and G.J. Kraft. 2001. Nitrate and chloride loading to groundwater from an irrigated north-central U.S. sand plain vegetable field. *J. Env. Qual.* 30:1176-1184.
- Taglia, P.J. 2001 Using *in situ* microcosms to evaluate the spatial heterogeneity of BTEX biodegradation under nitrate-reducing conditions. MS Thesis. Department of Geology, University of Wisconsin-Madison, Madison, WI.
- Zwolinski, M.D., R.H. Harris, and W.J. Hickey. 2001. Microbial consortia involved in the anaerobic degradation of hydrocarbons. *Biodegradation* in press.

FEDERAL AGENCY PARTNERS

U.S. Geological Survey: Water Resources Division - Wisconsin District

The mission of the U.S. Geological Survey-Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States. This mission is accomplished, in large part, through cooperation with other Federal, State and local agencies, by:

- Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.
- Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and physical, chemical, and biological characteristics of surface water and ground water.
- Conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to stress.
- Disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases.
- Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.
- Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies, to licensees of the Federal Energy Regulatory Commission, and to international agencies on behalf of the U.S. Department of State.

The Wisconsin District is currently conducting cooperative projects that have a significant groundwater component with the DNR, WGNHS, Southeast Wisconsin Regional Planning Commission (SEWRPC), LaCrosse, Dane and Sauk Counties and the Menominee and Stockbridge-Munsee Tribes of Wisconsin. In addition, several projects are funded by Federal agencies: EPA-Region V and USGS. On going projects that have a significant ground-water component are listed below.

Ongoing projects with state and local agencies

1. Ground-water observation well network
2. Wisconsin water-use data file
3. Southeast Wisconsin Hydrologic Study
4. LaCrosse, Dane and Sauk County Groundwater Studies
5. Susceptibility of La Crosse municipal wells to enteric virus contamination from surface water.
6. Hydrologic review of proposed zinc-copper mine near Crandon
7. Delineation of zones of contribution for several Menominee towns
8. Monitoring contaminant flux from a storm water infiltration facility to groundwater

Ongoing projects with Federal agencies

1. Area-wide brownfield assessment – Menomonee Valley, Milwaukee (EPA)
2. Hydrologic and biogeochemical budgets in temperate lakes and their watersheds, Northern Wisconsin (USGS)
3. Western Lake Michigan Drainages National Water-Quality Assessment (USGS)
4. Groundwater/surface water Interaction – Mississippi River, Pool 8 (USGS-Biological Resources Division)

A summary of the Wisconsin District projects and listing of publications is published annually in "Water-Resources Investigations in Wisconsin." Copies of the summary are available at the Wisconsin District Office or by calling 608/821-3801.

For more information please contact Jim Krohelski, USGS, 8505 Research Way, Middleton, Wisconsin, 53562-3581 (608/821-3850), jtkrohelski@usgs.gov or visit the Wisconsin District web page (<http://wi.water.usgs.gov>).

USDA Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) is a federal agency within the U.S. Department of Agriculture. The NRCS, formerly the Soil Conservation Service, works with private landowners to promote conservation of natural resources. The agency protects groundwater by providing technical assistance to landowners through the following ongoing conservation practices and programs:

- Nutrient management: management of the amount, form, placement and timing of nutrients applied to the soil so that the amount applied is only what is needed to produce optimum crop yield. This reduces the potential for applied nutrients to pollute surface and groundwater.
- Pest management: utilization of environmentally sensitive prevention, avoidance, monitoring and suppression strategies to manage weeds, insects, diseases, animals and other organisms that directly or indirectly cause damage or annoyance. This enhances quantity and quality of commodities. It also minimizes negative impacts of pest control on soil resources, water resources, air resources, plant resources, animal resources and/or humans.
- Animal waste storage: proper waste storage siting and design is imperative to protect groundwater from contamination by nutrients in animal waste.
- Comprehensive Nutrient Management Plan (CNMP): a conservation system unique to livestock farms. It is a grouping of conservation practices and management activities to insure both production and resource protection goals. It addresses soil erosion, manure, and organic by-product impact on surface and groundwater quality. CNMP components include nutrient management based on phosphorus or nitrogen, manure and wastewater handling and storage, adequate erosion control of cropland, and proper record keeping. It may also include feed management to reduce phosphorus in manure and other manure use alternatives such as biofuel production and composting.
- Farm*A*Syst Program: a site assessment program to determine areas of possible groundwater contamination on a farm or rural home - enables individuals to apply management practices to their own property. <http://www.wisc.edu/farmasyst>
- Wetland Reserve Program: restores wetlands through permanent or 30-year easements or 10-year contracts.
- Environmental Quality Incentives Program: provides cost sharing for conservation practices on agricultural land. Statewide priorities include groundwater protection practices such as well decommissioning and nutrient and pesticide management and prescribed grazing.
- Well decommissioning: proper decommissioning is essential to prevent contaminants from entering groundwater through abandoned wells, which are direct conduits to the groundwater.
- Conservation Reserve Program/Conservation Reserve Enhancement Program: participants establish permanent vegetative cover on agricultural lands in return for guaranteed rental payments.
- Dam rehabilitation pilot project: From the 1950s to 1980s, NRCS built 87 small flood control dams in Wisconsin that reduced flooding and improved groundwater infiltration. Since 2000, NRCS has planned or completed the rehabilitation of 9 deteriorating dams in seven western counties as part of a four state pilot project. Planning will begin on 9 more dams soon.

The agency also provides leadership in the following:

- Interagency committee to find improved joint sealers for concrete animal waste storage structures. These sealers are critical to the groundwater protection provided by these structures.

- Interagency Committee to revise NRCS Conservation Practice Standards. Practice Standards benefit the public by helping to protect groundwater. For example NRCS Practice Standard Code 590 – Nutrient Management was recently completed. This revision enhances groundwater protection by minimizing agricultural nonpoint source pollution of surface and groundwater resources.

To find out more information about NRCS, go to the home page at <http://www.wi.nrcs.usda.gov>, contact Renae Anderson at 608-276-8732 ext. 227, or Jim Kaap at 608-276-8732 ext. 266.

GROUNDWATER MONITORING AND RESEARCH

CONDITION OF THE RESOURCE - GROUNDWATER QUALITY

As part of 1983 Wisconsin Act 410, the Groundwater Account of the Environmental Fund was created to support groundwater monitoring by state agencies to determine the extent of groundwater contamination in Wisconsin and identify the sources of contamination. Groundwater monitoring has found that the primary contaminants of concern are volatile organic compounds (VOCs), pesticides and nitrate. Each is discussed below, in addition to sections on biological hazards, radioactivity, and arsenic.

Volatile Organic Compounds

VOCs volatilize under normal temperatures and pressures. Examples of VOCs include gasoline and industrial solvents, paints, paint thinners, drain cleaners, air fresheners, and household products (such as spot and stain removers). Short-term exposure to high concentrations of many VOCs can cause nausea, dizziness, tremors or other health problems. Some VOCs are suspected of causing cancer upon long-term exposure.

Sources of VOCs in Wisconsin's groundwater include landfills, underground storage tanks, and hazardous substance spills. The DNR requires monitoring at state Environmental Repair Fund sites, abandoned facilities, Comprehensive Environmental Response Compensation Liability Act (CERCLA- Superfund), LUST, and spill sites. Thousands of wells have been sampled for VOCs. Fifty-nine different VOCs have been found in Wisconsin groundwater. Trichloroethylene is the VOC found most often in Wisconsin's groundwater.

Wisconsin has 80 active, licensed solid waste landfills, all of which are required to monitor groundwater. In addition, the DNR currently tracks more than 9,400 LUST sites, 4,000 waste disposal facilities, and about 1,400 high priority Environmental Repair sites. Many of these sites have been identified as sources of VOCs. Facilities include gas stations, bulk petroleum and pipeline facilities, plating, dry cleaning, industrial facilities, and abandoned non-approved unlicensed landfills.

Landfills. Two studies conducted over a four-year period revealed that out of 45 unlined municipal and industrial landfills, 27 (60%) had VOC contamination in groundwater. All of these landfills are currently closed. Six landfills with liner and leachate collection systems were also sampled and no confirmed VOCs were detected. VOCs contaminated groundwater at 21 (81%) of the 26 unlined municipal solid waste landfills included in the two studies. While 20 different VOCs were detected overall, 1,1 – Dichloroethane was the most commonly occurring VOC at all solid waste landfills. The two DNR publications – “Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills”, dated February 1988, and “VOC Contamination at Selected Landfills – Sampling Results and Policy Implications”, dated June 1989 – further describe the research results. In a follow-up VOC study conducted from July 1992 through July 1994, the DNR reviewed historical data and sampled groundwater at 11 closed, unlined landfills and at six older, lined landfills. VOC levels have decreased after closure at all but two of the unlined landfills, though at many sites VOC levels do not show continued decline. Also, the level of contamination remains high at many closed sites. No VOC contamination was attributable to leachate migration at any of the six older, lined landfills.

Over the past few years increasing numbers of residential developments have been located close to old, closed landfills. Further, it has been recently discovered that several of these landfills are impacting groundwater. In 1998 and 1999 the DHFS sampled private wells down-gradient of 19 small, closed landfills in one county. Several of the private wells had results above maximum contaminant levels. The results of this sampling showed that there may be more landfills with serious problems that have not yet been identified.

The DNR Bureau of Waste Management, Remediation and Redevelopment, and Drinking Water and Groundwater in cooperation with the DHFS, responded to this issue in early 1999 by choosing 16 old, closed landfills – at least three from each of the five regions across the state - that have private wells nearby and may be impacting groundwater. Private wells around each of the landfills were sampled in 1999 and significant levels of contamination were found. Of the 113 wells that were tested, 31 had detects of VOCs. Fourteen of the homes had levels exceeding drinking water standards and have been given health advisories not to drink their water.

Underground storage tanks. Wisconsin requires underground storage tanks with a capacity of 60 gallons or greater to be registered with Commerce. This registration program has identified a total of 175,539 tanks as of June 17, 2002 of which 78,597 tanks are regulated by the federal underground storage tank program. Only 12,753 regulated tanks are currently in use. A federally regulated tank is any tank, excluding exempt tanks, that is over 110 gallons in size, has at least 10 percent of its volume underground, and is used to store a regulated substance. Exempt tanks include: farm or residential tanks of 1,100 gallons or less; tanks storing heating oil for consumptive use on the premises where stored; septic tanks; and storage tanks situated on or above the floor of underground areas, such as basements and cellars.

Underground storage tanks over 110 gallons have been federally regulated since 1988. As of August 1, 2002, DNR records indicate there are 3,600 active underground storage tank contamination cleanups and approximately 4,600 open sites. The contaminants most commonly associated with leaks from petroleum underground storage tanks are benzene, toluene, ethyl benzene, and xylene (BTEX compounds). More than 5,000 LUST sites have BTEX groundwater standards exceedances. Drinking water at more than 600 households has been contaminated by leaks from underground storage tanks.

Hazardous waste. Hazardous waste treatment storage and disposal facilities are another VOC source. The DNR Bureau for Remediation and Redevelopment is investigating or remediating contamination at 27 sites. Approximately 140 sites statewide are subject to corrective action authorities. However, only a small percentage will follow the corrective action process because of minimal contamination at the site or jurisdiction under other regulatory authorities.

Generators improperly managing hazardous waste are another source of VOC contamination. All new generator remediation cases statewide and many existing actions are to be addressed in accordance with the NR 700 Wis. Adm. Code series.

Hazardous Substance Spills. The Hazardous Substance Spill Law, ch. NR 292.11 Wis. Stats, requires immediate notification when hazardous substances are discharged, as well as taking actions necessary to restore the environment to the extent practicable. Approximately 800 discharges are reported annually to the DNR, and of those, approximately 65% are petroleum related, with another 15% being agrichemicals. The NR 700 Wis. Adm. Code series, specifically ch. NR 706, contains the requirements for notification when a discharge or spill occurs. Chapter NR 708 contains requirements for taking immediate and/or interim actions when releases occur. Groundwater monitoring is performed when necessary to delineate the extent of contamination. The spills program develops outreach materials to help reduce the number and magnitude of spills and provide guidance for responding to spills. Topics addressed include spills from home fuel oil tanks, responses to illegal methamphetamine labs, and mercury spills, all of which can lead to significant environmental impacts, if not properly addressed.

Pesticides

Pesticide contamination in groundwater results from field applications, pesticide spills, misuse, or improper storage and disposal. Serious concerns about pesticide contamination in Wisconsin were first raised in 1980 when aldicarb, a pesticide used on potatoes, was detected in groundwater near Stevens Point. The DNR, DATCP, and other agencies responded to these concerns by implementing monitoring programs and conducting groundwater surveys.

The DNR and DATCP expanded their sampling programs in 1983 to include analysis of pesticides commonly used in Wisconsin. The most commonly detected pesticides in Wisconsin groundwater are:

- Metabolites of alachlor (Lasso) and metolachlor (Dual)
- Atrazine and its metabolites
- Metribuzin (Sencor)
- A breakdown product of Cyanazine (Bladex). Cyanazine is no longer manufactured.

Federal and state groundwater quality standards for many of these compounds were also adopted. To date, standards for over 30 pesticides are included in ch. NR 140, Wis. Adm. Code.

Chloroacetanilide herbicide metabolites are increasingly being detected in Wisconsin groundwater. In a study completed in 2000, 27 monitoring wells, 22 private drinking water wells, and 23 municipal wells in Wisconsin were sampled for alachlor, metolachlor, acetochlor, and their ethane sulfonic acid (ESA) and oxanilic acid (OA) metabolites. Wells were selected based on previous detections of pesticides or proximity to agricultural fields. Alachlor, metolachlor, and acetochlor are chloroacetanilide herbicides that are commonly used on corn and other crops in Wisconsin. With the exception of alachlor ESA, no historical data exists for these metabolites in Wisconsin groundwater because laboratory methods were not previously available. Over 80 percent of the monitoring wells and drinking water wells contained the ESA and OA metabolites of alachlor and metolachlor. The metabolites of acetochlor showed a lower frequency of detection. Metabolite concentrations ranged from near the level of detection to 42 µg/L. Monitoring wells and private drinking water wells showed higher detection frequencies and concentrations than the deeper municipal wells, but the municipal wells did show significant impacts. Fifty-two percent of the municipal wells had at least one detection. No municipal well had pesticide levels that exceeded an enforcement standard.

Beginning in October 2000 and ending in May 2001, DATCP collected 336 samples from private drinking water supplies to determine the statewide impact of pesticides on groundwater resources. DATCP analyzed the samples for commonly used herbicides including the chloroacetanilide herbicides and their metabolites. This study also was compared to previous surveys to attempt to understand trends in groundwater quality over time. Results from this survey have been summarized in the May 2002 report “Groundwater Quality: Agricultural Chemicals in Wisconsin Groundwater” available at http://datcp.state.wi.us/arm/agriculture/land-water/water-quality/monit_proj.html. A total of seven common herbicides, ten metabolites and nitrate were included in the latest survey. Highlights from this overall study show:

- The estimate of the proportion of wells that contain a detectable level of a herbicide or herbicide metabolite is 37.7%.
- Alachlor ESA and metolachlor ESA are the most commonly detected herbicide compounds with proportion estimates of 27.8 and 25.2%, respectively.
- A significant decline in parent atrazine concentrations between 1994 and 2001.

In 1991, the Wisconsin State Laboratory of Hygiene (WSLH) began a public testing program using an immunoassay screening test for triazine-based compounds. The triazine immunoassay screen uses specific antibodies designed to selectively bind to target compounds that are present at low concentrations. This screening test is available to the public at a low cost via an 800 telephone number. DNR funds a part time staff position to assist in the quality control process for data collection and well location verification.

In a recent survey of DNR groundwater databases, more than 14,000 triazine screen results have been recorded. 42% of the samples had a detection for a triazine compound; 13% exceeded the PAL for atrazine of 0.3 ppb; and 1.6% exceeded the ES for atrazine of 3.0 ppb.

The immunoassay triazine analysis detects atrazine and certain similar compounds, but does not detect two of the three atrazine metabolites included in the groundwater standard. While there is no ES for the triazine screen, comparing the triazine results to the ES and PAL for atrazine provides a reference point for the severity of contamination. Atrazine has been used heavily in Wisconsin and there have been relatively few detects of other triazine compounds in groundwater.

In 1997, DATCP investigated differences between the triazine screen and gas chromatography results for atrazine. DATCP, with support from DNR, collected 49 split samples for analysis by the WSLH and DATCP laboratories. Results of this study showed that 33% of the wells that were below the 3 ppb ES for atrazine based on a triazine screen were above the ES level when analyzed by gas chromatography. This is because the triazine screen does not detect all the atrazine metabolites and therefore underestimates the total atrazine concentration. Based on this information, the WSLH now advises homeowners that the triazine screen results should be used for initial screening purposes only. Higher triazine detects often receive a followed-up gas chromatography test.

The following are other DATCP pesticide related studies conducted recently or as part of ongoing research.

Exceedence Survey. In 1995, DATCP completed a re-sampling of 122 Wisconsin wells that previously exceeded a pesticide enforcement standard. Most of the wells in the survey had exceeded standards for atrazine. Most were also within an atrazine prohibition area. Of wells exceeding standards for atrazine, 84% had declined in concentration and 16% had increased. About 50% of well owners continued to use their contaminated well and about 25% had installed new wells at an average cost of \$6,300. This survey has been repeated annually through 2001, with samples collected from 150 different wells at least once during this time period. In 2001, 71 private wells that have historically exceeded groundwater standards were sampled. Thirty-two percent of the wells tested above the atrazine enforcement standard and 68% tested below the standard.

Pesticide and Groundwater Impacts Study. In 1985, DATCP began a 2-year study funded by the Wisconsin Department of Natural Resources (DNR) to evaluate the potential impact of agriculture on groundwater quality. The study focused on areas of the state with high groundwater contamination potential. In 2001, this study entered its 16th program year. In 2001, 29 samples from monitoring wells near 25 agricultural fields were sampled. A total of ten compounds were detected in groundwater. Three of these (nitrate, alachlor ESA and atrazine + metabolites) were found at levels above an existing enforcement standard. Other compounds detected include alachlor, acetochlor ESA, metribuzin, metolachlor and its metabolites ESA and OS, and cyanazine amide.

Monitoring Reuse of Atrazine in Prohibition Areas - In FY 98, DATCP began monitoring the limited reuse of the herbicide atrazine in selected areas where atrazine use has been prohibited. DATCP is gathering data to see if renewed atrazine use at current restricted use rates will cause groundwater contamination. DATCP is monitoring groundwater quarterly at 17 fields, 10-40 acres in size, for 5 years. Although it is too early in the project to make recommendations, 1998 through 2001 summary data showed that atrazine concentrations increased at all but one site. One or more wells at 14 of 17 of sites exceeded the enforcement standard for atrazine (3.0 parts per billion) at some time during the first 3 years of the project. The nitrate enforcement standard was exceeded at 100% of these sites over the same sampling period.

Atrazine Rule Evaluation Survey. In FY 97, DATCP completed a groundwater sampling survey designed to evaluate the effectiveness of the Atrazine Rule (ch. ATCP 30, Wis. Adm. Code). The survey, required under ATCP 30, was to determine if a "statistically significant change" occurred in groundwater concentrations of atrazine and its three chlorinated metabolites between Phases 1 (1994) and 2 (1996) of the survey. The survey showed a statistically significant decline in the level of atrazine contamination in Wisconsin groundwater between 1994 and 1996. However, atrazine still reaches groundwater and in some cases exceeds the enforcement standard. The Atrazine Rule appears to be effective in reducing atrazine contamination of groundwater. DATCP recommends that current limits on atrazine use be continued.

In 2000 and 2001, Water Quality Section staff sampled 336 private wells across the state that included 122 of the same wells sampled in 1996. Results of this survey show that the proportion of wells that contained a detectable level of parent atrazine showed a statistically significant decline between 1994 and 2001. However, a decline in total chlorinated residues of atrazine was not apparent.

Nitrate

Nitrate-nitrogen is the most common contaminant found in Wisconsin's groundwater. Detections of nitrate in private water supplies frequently exceed the state drinking water standard of 10 milligrams/liter (mg/L). A 1994 study by WGNHS and DHFS estimated that 9 to 14% of private water wells in Wisconsin exceed the nitrate standard. As part of an analysis to provide baseline groundwater data for the State of the Basin Reports, the most recent nitrate sample from each well in the GRN data base was extracted. Of 10,105 well samples, 2016 (20%) equaled or exceeded the enforcement standard of 10 mg/L. In the same data set, 5113 (50%) were equal to or exceeded the PAL (2 mg/L). A statewide groundwater sampling program completed by DATCP in 2001 estimated that the proportion of private drinking water wells in the state that exceed the 10 mg/L health standard was 14.1%.

Consumption of water that contains high concentrations of nitrate by infants under 6 months of age can induce a condition called methemoglobinemia or "blue baby syndrome." This condition occurs when red cell hemoglobin is oxidized to a form that is unable to carry oxygen to the body's tissues. All infants are at risk of nitrate poisoning, but those suffering from gastrointestinal illnesses appear to be more sensitive than are healthy infants. DHFS staff completed a summary of two cases from southern Wisconsin in which infants developed methemoglobinemia after being fed formula that was prepared with well water (Knobeloch et al. 2000). One of these infants required emergency air transport and life-saving therapy. The nitrate levels involved in these cases ranged from 22.9 to 28 mg/L (as N).

The chronic health effects of nitrate exposure are not well understood; however, many experts believe that long-term exposure may increase the risk of cancer. This theory is supported by some scientific studies. For example, in 1996 researchers in the Netherlands found that residents who consumed water that was high in nitrate had higher levels of cancer-causing nitroso compounds in their urine (Van Maanen et al., 1996). These researchers also found that genes in the blood cells of these individuals had higher numbers of mutations. Two years earlier, these same researchers had reported a link between consumption of high-nitrate water and the incidence of thyroid disorders (Van Maanen et al., 1994). In 1996, a study conducted jointly by the National Cancer Institute, the University of Nebraska, and Johns Hopkins University found an association between nitrate-contaminated water and Non-Hodgkin's lymphoma (Ward et al., 1996). A large cohort study conducted jointly by the University of Iowa, Mayo Clinic and the University of Minnesota found a positive association between nitrate levels in municipal water supplies and the incidence of bladder and ovarian cancer among adult women (Weyer et al. 2001).

Private water supply wells should be tested for nitrate at the time of installation and at least every five years during their use. In 1989, the GCC endorsed a resolution recommending that newly constructed water supply wells be sampled for nitrate in addition to coliform bacteria. Testing is also recommended for wells used by pregnant women and is essential for wells that serve infants less than 6 months of age.

Nitrate can enter groundwater and surface water from a variety of sources including farm fields, septic tanks, animal feedlots, decaying vegetation, and urban storm water. Contamination is difficult to prevent. Although the Department of Commerce continues to evaluate state-of-the-art septic system designs for nitrate removal, septic tanks continue to be a significant source of nitrate in heavily populated, unsewered areas. DATCP proposed regulatory authority for fertilizer use in the FY 96-97 budget but the proposal was not approved. In 1997, Wisconsin Act 27 required the development of performance standards for a number of agricultural and non-agricultural practices to reduce non-point sources of pollution of surface and groundwater. These performance standards include nutrients applied to cropland and DATCP was directed to develop a nutrient management program. During 2000 and 2001, DATCP and DNR conducted public hearings and proposed changes to their non-point pollution control rules to include nutrient management standards and practices. These rules were adopted by the Natural Resources Board in spring of 2002 and subsequently passed legislative review. The rules will be promulgated in October 2002. Adoption and implementation of nutrient management standards, based on UW recommendations, will reduce the over-application of nitrogen that occurs on some farms. This will dramatically reduce the amount of nitrate that would be available to leach to groundwater.

Owners of nitrate-contaminated water supplies have few options. They do not qualify for well-compensation funding unless the nitrate level in their well exceeds 40 mg/L (as N) and a dairy herd uses the well. In order to establish a safe water supply, they may opt to replace an existing well with a deeper, better cased well or to connect

to a nearby public water supply. Alternatively, they may choose to install a water treatment system or to use bottled water. A study published by DHFS in 1999 examined this issue (Schubert et al. 1999). Their survey of 1500 families found that few took any action to reduce nitrate exposure. Of those who did, most purchased bottled water for use by an infant or pregnant woman.

References cited:

- Knobeloch, L., B. Salna, A. Hogan, J. Postle and H. Anderson. 2000. Blue babies and nitrate-contaminated well water. *Environ. Health Perspect.* Vol. 108, no. 7.
- Schubert, C., L. Knobeloch, M.S. Kanarek, and H.A. Anderson. 1999. Public response to elevated nitrate in drinking water wells in Wisconsin. *Arch. Environ. Health* 54(4):242-2247.
- Van Maanen, J.M.S, I. J. Welle, G. Hageman, J.W. Dallinga, P. Mertens and J.C.S. Kleinhans. 1996. Nitrate contamination of drinking water: Relationship with HPRT Variant frequency in lymphocyte DNR and urinary excretion of N-nitrosamines. *Environ. Health Perspect.* Vol. 104. no. 5.
- Van Maanen, J.M.S., A. van Dijk, K. Mulder, M.H. de Baets, P.C.A. Menheere, D. van der Heide, P.L.J. Mertens and J.C.S. Kleinjans. 1994. Consumption of drinking water with high nitrate levels causes hypertrophy of the thyroid. *Toxicol. Letters*, 72:365-374.
- Ward, M.H., S.D. Mark, K.P Cantor, D.D. Weisenburger, A. Correa-Villasenor, and S.H. Zahm. 1996. Drinking water nitrate and the risk of non-Hodgkin's lymphoma. *Epidemiol.* 7(5):465-71.
- Weyer, P.J., J.R. Cerhan, B.C. Kross, G.R. Hallberb, J. Kantamneni, G. Breuer, M.P. Jones, W. Zheng and C.F. Lynch. 2001. Municipal drinking water nitrate level and cancer risk in older women: The Iowa Women's Health Study. *Epidemiology* 11:3.

Biological Hazards

Biological contamination often occurs in areas where there is little natural attenuation potential. This is common in areas where the depth to groundwater or the depth of soil cover is shallow, or in areas of fractured bedrock. Biological agents include bacteria, viruses, and parasites. These agents can cause acute illness and result in life-threatening conditions for some population groups. Approximately 23% of well water samples statewide test positive for total coliform bacteria, an indicator species of other biological agents (Warzecha et al 1995). Approximately 3% of well water samples test positive for *E. coli*, an indicator of water borne disease that originates in the mammalian intestinal tract. The DNR recommends that well owners test for biological quality annually or when there is a change in taste, color, or odor of the water.

In an effort to address concerns arising from possible airborne bacteriological contamination of wells, the WSLH completed a study investigating the role of air-borne particulates as the cause of unexplained coliform contamination in drilled wells (Trest et al. 1998). Samples were collected from 165 well sites located throughout Wisconsin. 96 of these recently experienced a total coliform positive. Of the 165 wells, 51% contained viable coliform organisms. Of the wells that had previous coliform positive, 61.5% of the air samples tested coliform positive. Of the wells that had no recent coliform positive, 36% of the air samples tested total coliform positive. Wells adjacent to positive air coliform samples were 1.7 times more likely to contain coliform bacteria than wells where the air coliform samples were negative. Wells located near vegetation, barnyards, pets, or fecal material; and samples collected within three hours of a rainfall event or where the grass had been recently mowed had relatively high percentages of air coliform positive samples. The study also determined that coliform bio-aerosols experimentally created near a wellhead are capable of artificially infecting a well.

Researchers at the Marshfield Medical Research and Education Foundation have investigated the association of pathogenic viruses and bacteria in private wells with incidences of infectious diarrhea and indicators of well water

contamination in a series of studies from 1997-2000 (Borchardt et al. 2000). In general, infectious diarrhea was not associated with drinking from private wells, nor was it associated with drinking from wells positive for total coliform. However, wells positive for enterococci were associated with children having diarrhea of unknown etiology (origin), which was likely caused by caliciviruses. Preliminary results indicate that the incidence of virus contamination in private wells is similar to or lower than that of community wells.

References cited:

- Borchardt, M. A., P. D. Bertz, B. T. Argue, S. K. Spencer, and D. A. Battigelli. 2000. Incidence of enteric viruses in ground water from private household wells. *Presented at* Department of Natural Resources Bureau of Drinking Water and Groundwater Statewide Meeting, September 25, 2000, La Crosse, WI.
- Trest, M. T., J. H. Standridge, S. M. Kluender, J.M. Olstadt, and W.T. Rock. 1998. A Study of the Role of Airborne Particulates as the Cause of Unexplained Coliform Contamination in Drilled Wells. University of Wisconsin State Laboratory of Hygiene and Wisconsin Department of Natural Resources. Unpublished report.
- Warzecha, C., R. Gerhardt, and S. Kluender. 1995. Wisconsin private well water quality survey. Wisconsin Department of Health and Social Services, Department of Natural Resources, and State Laboratory of Hygiene. Unpublished report.

Naturally-occurring Radioactivity

Naturally-occurring radioactivity in groundwater, including uranium, radium, radon, and gross alpha is becoming an increasing concern. Sampling has identified radionuclides in groundwater in north-central Wisconsin, high levels of radium in water supplies in eastern Wisconsin, and gross alpha problems in northeastern and southeastern parts of the state. Nearly 70 public water systems either exceed or are nearing the drinking water standard of 15 pCi/L for gross alpha activity. The DNR is enforcing the revised radionuclide standard adopted into NR 809 in October 2001. All systems that do not meet the current standards for gross alpha or radium will be asked to submit treatment plans and specifications, and to return to compliance by December 2003.

Two studies have been initiated by the DNR to address concerns about radioactive compounds in groundwater. The first titled "Identification and Quantitation of Alpha Emitting Radiochemicals in Drinking Water", began in FY 00. DNR staff collected samples from about 100 community and nontransient noncommunity public water wells. Each sample will be analyzed for several alpha emitting radiochemicals in an attempt to identify and quantify the relative contribution of each chemical to the total gross alpha activity in the samples. WSLH will analyze for total Uranium (U-238, U-234, U-235) alpha activity, total Thorium (Th-228, Th-230, Th-232) alpha activity, Radium 226, and Polonium 210 alpha activities. Preliminary results indicate total uranium is the major contributor to high gross alpha activities. Small quantities of polonium and thorium have also been detected but they do not appear to be major contributors to the total gross alpha activity in public water system wells.

A second study "Factors Effecting the Determination of Radon in Groundwater" will help determine the impact of expected new EPA standards for radon in drinking water. Staff from the DNR will sample about 340 noncommunity, nontransient and other than municipal water systems per year. To date, approximately 250 samples have been collected from nontransient, noncommunity wells. Preliminary results tend to support findings from earlier community water system monitoring which indicated that approximately 50% of the public water systems monitored in Wisconsin exceed the proposed radon standard of 300 pCi/L. As of July 2002, EPA has not finalized the drinking water standard for radon.

Summaries of the gross alpha and radon studies are available on the WSLH web site at <http://www.slh.wisc.edu/radiochem/research.html>.

Arsenic

Naturally occurring arsenic has been detected in wells throughout the State of Wisconsin. Department of Natural Resources historic data show that 3,386 public wells and 1,821 private wells have detectable levels of arsenic. These samples were taken randomly over the years with more public well water being tested for arsenic than private well water. Arsenic has been detected in public well water samples in every county in Wisconsin. However, the problem is especially prevalent in northeastern Wisconsin where increased water use has likely mobilized arsenic into the groundwater. In a portion of Outagamie, Shawano, Winnebago, and Brown Counties approximately one out of three private drinking water wells sampled have arsenic detects. The highest concentration of arsenic detected in a private well in Wisconsin is 15,000 µg/L.

Arsenic bearing geologic units exist across the state. It is found in the igneous rocks of the Precambrian shield, the Paleozoic sedimentary rock, and within glacial deposits. The highest concentrations are present in the sedimentary bedrock. Results from several DNR studies indicate the geochemical phenomena causing the elevated levels of arsenic in groundwater are associated with oxidation of sulfide-mineralized zones within the bedrock aquifers. The main zone of mineralization extends some ten feet below the base of the Platteville Dolomite, which is part of the main upper bedrock formation of this region. If the St. Peter Sandstone is present within the geologic sequence, it lies directly below the Platteville Dolomite and the arsenic-rich mineralized zone then extends about ten feet into this sandstone. Although it is certain that this is the main mineralized zone, experts believe that there are other lateral and vertical occurrences of arsenic-rich strata.

Arsenic Advisory Area - Studies conducted by DNR led to the delineation of the extent of the arsenic contaminated area. This delineation led to the establishment of an “Arsenic Advisory Area” in the early 1990s. This area includes the strip of land five miles either side of the bedrock subcrop of the St. Peter Sandstone, extending in a northeasterly trend, from a location just southwest of Oshkosh, to a location just west of Green Bay. For this area, DNR developed special well construction specifications, more stringent than the minimum Private Well Code requirements. DNR guidance recommends the installation of 80 feet of casing through the sandstone contact for drinking water wells in the AAA. These specifications were recommended, but not required, for new wells constructed within the “Arsenic Advisory Area”. The specifications, when followed, will increase the likelihood of installing a well free of arsenic. A special casing and construction area has been established for the Town of Algoma in Winnebago County. In this area, all wells must be drilled with mud/wash rotary methods with a 10-inch upper enlarged drillhole, Bradenhead grout methods and cased to the Cambrian sandstone aquifer.

Ongoing research indicates that casing off the upper parts of the St. Peter Sandstone is usually effective in eliminating or reducing the presence of arsenic in drinking water. However, over the last several years some wells that were constructed according to guidance have exhibited increasing arsenic concentrations and have required replacement or reconstruction. In addition, follow-up testing on 50 replacement wells found that arsenic levels are exceeding standards in at least 5 cases where initially they had been below the ES. Additional sampling of replacement wells will occur in FY 02 to test whether current guidelines are adequate at lowering arsenic concentrations.

Recent information has raised questions about the St. Peter Sandstone – Sinnipee Dolomite contact being the only location where high arsenic concentrations are found. A renewed effort is currently underway to reexamine this problem. In addition, there is evidence to suggest that increased levels of arsenic in this region may be related to increased groundwater consumption³. In many areas, increasing concentrations of arsenic may be a result of the water table dropping to levels at or just below the sulfide rich mineralized zone and then fluctuating up and down across this layer. This fluctuation can allow oxygen in the air to come in contact with and oxidize the sulfide

³ Since the 1950s, groundwater consumption in northeastern Wisconsin has risen significantly due to an increase in population and per capita water use. Thousands of new private wells have been constructed in this region. Municipal and industrial groundwater use has increased. As a result, regional groundwater levels in the sedimentary bedrock aquifers of northeastern Wisconsin have shown a steady long-term decline. The decline has averaged as much as three to four feet per year in the Green Bay area and as much as two to three feet per year in the Fox Cities area surrounding the City of Appleton.

minerals in this layer. This initial oxidation can then trigger a complex set of geochemical reactions that can eventually release arsenic into the groundwater. Once this reaction has been initiated it is likely to continue.

Health Effects – National health experts agree that consuming water containing arsenic has many adverse health effects. Wisconsin Department of Health and Family Services' toxicologists have reviewed the existing toxicological information and have produced an "Arsenic in Drinking Water" brochure documenting the potential health problems linked to consuming water containing arsenic. The brochure informs the public that drinking arsenic contaminated water has been associated with skin cancer; internal cancers (bladder, prostate, lung and other sites); thick rough skin on hands and feet; unusual skin pigmentation; numbness in the hands and feet; circulatory disorders; tremors; and stomach pain, nausea, and diarrhea.

On October 31, 2001 EPA announced that the Federal Drinking Water Standard for arsenic would be lowered from 50 parts per billion ($\mu\text{g/L}$) for public water systems to 10 $\mu\text{g/L}$. EPA had previously delayed the rule in order to look at new studies regarding the health effects and to analyze economic issues associated with arsenic especially costs to small systems. The new standard became effective in February 2002 and compliance must be reached by 2006. The arsenic rule affects municipally owned water systems and those that serve an average of at least 25 people daily for six months of the year, among them schools, mobile home parks, apartment buildings, day care centers, and factories.

Raw water samples submitted as part of a DNR and State Laboratory of Hygiene study indicated that approximately 80 public water systems contain arsenic levels exceeding 10 $\mu\text{g/L}$. However, some of those systems are already reducing arsenic to the federal health standard when they treat their raw water for other contaminants, such as iron. The 80 systems are equally divided among the Municipal, Other Than Municipal, and Non Transient Non Community water system categories.

The new standard also raises questions for private water supplies, particularly in regards to health risks associated with drinking water with moderate levels of arsenic (between the old and new standards). Historical data indicates that 37% of the wells in the 4-county area affected by arsenic exceed 5 $\mu\text{g/L}$, while 20 percent are over the new standard of 10 $\mu\text{g/L}$. In FY 01, the DHFS received funding to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR staff, town clerks and others have conducted well sampling campaigns in 21 townships in the affected counties. Several other towns have offered similar well testing programs. 2233 households have submitted samples and returned health surveys, providing health and exposure information for 6669 individuals. In two of the townships, almost 50% of the samples tested in the current campaign exceed 5 $\mu\text{g/L}$ while 34% exceed 10 $\mu\text{g/L}$.

CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY

Groundwater is plentiful in Wisconsin, but concern is growing about its limits. Natural shortages of groundwater have occurred due to weather conditions and geologic setting. Human activities also cause quantity problems. A dripping faucet, for example, can waste 20 or more gallons of water each day. Groundwater withdrawals in the Lower Fox River Valley, southeastern Wisconsin, and Dane County have caused substantial declines in groundwater levels.

In 1997, the Wisconsin Groundwater Coordinating Council (GCC) addressed groundwater quantity issues in a report entitled "Status of Groundwater Quantity in Wisconsin." The Groundwater Section of the DNR's Bureau of Drinking Water and Groundwater prepared this report with the assistance of a Technical Advisory Committee (TAC). The full report is available from the DNR and may be downloaded at <http://www.dnr.state.wi.us/org/water/dwg/gw/Pubdwlnld.htm>. Some of the findings of the report are:

- Despite a general abundance of groundwater in Wisconsin, there is a growing concern about the overall availability of good quality groundwater for municipal, industrial, agricultural, and domestic use and for adequate baseflow to our lakes, streams, and wetlands. Groundwater quantity problems have occurred naturally

and from human activities.

- The effects of groundwater withdrawals are well documented on a regional scale in the Lower Fox River Valley, southeastern Wisconsin, and Dane County. There are substantial declines in groundwater levels in these three areas. Localized effects from groundwater withdrawals are not as well documented as the regional effects. Cases exist around the state where wells, springs, and wetlands have gone dry; lake levels have dropped; streamflow has been reduced; and contamination has prevented installation of new wells.
- The availability of groundwater may also be affected by groundwater quality, both due to naturally-occurring substances in groundwater and human-caused contamination.
- Groundwater use grew from 570 to 754 million gallons per day (Mgal/d) from 1985 to 1995.
- Groundwater withdrawals can affect both groundwater and surface water.
- There is an ongoing effort by state and federal agencies and university staff to gather data and information on groundwater quantity issues. However, additional information is needed to increase our understanding of groundwater-surface water interactions, identify areas with groundwater quantity problems, and determine the impacts of groundwater withdrawals.
- The DNR is the "central unit of government to protect, maintain, and improve the quality and management of the waters of the state, ground and surface, public and private." Other agencies involved in groundwater quantity issues include the WGNHS, Central Wisconsin Groundwater Center, GCC, Public Service Commission, the USGS, local units of government and water utilities.
- Groundwater quantity will continue to be an issue of concern in Wisconsin. A coordinated effort is needed to determine appropriate management options for addressing groundwater withdrawals, to prioritize information needs, and to implement information and education programs. Funding is needed for additional data collection and research to address groundwater quantity management issues.

Since publication of that report, other developments have further highlighted the importance of groundwater quantity. Two communities, Green Bay and Oak Creek, have proposed aquifer storage and recovery as a method for addressing water shortages. Aquifer storage and recovery (ASR) involves injecting treated water into the aquifer during times of less groundwater use and pumping that water out when water demand is high, typically during the summer. Both communities are working with the WDNR on pilot studies to determine if this is feasible in Wisconsin. In addition, the communities around Green Bay are considering whether to construct a pipeline as Green Bay has done to withdraw water from Lake Michigan.

One of the impacts of groundwater over-pumping in the Lower Fox River Valley has been increased detections of arsenic in private well water in recent years. Some of the arsenic concentrations found in groundwater have been quite high, with 20% of wells sampled over the new standard of 10 ppb. Investigations in the affected area indicate that most of the arsenic is coming from a highly mineralized zone at the top of the St. Peter Sandstone. It appears that over-pumping in the Lower Fox River Valley has drawn down the bedrock aquifer to such an extent that the mineralized zone is exposed to the atmosphere and becomes oxidized, releasing arsenic.

In 2000, Perrier proposed installing one or more wells in the Big Springs area in southeastern Adams County to pump out groundwater to be bottled and sold as spring water. Many local residents opposed the Perrier proposal because of concern about potential impacts to the spring. The WDNR issued an approval with conditions to protect the aquifer. The proposal highlighted the issue that, for high capacity wells, the WDNR only had authority to approve a high capacity well application if it is determined that the new well will interfere with a municipal water supply well.

Recently, attention has focused on the state's limited authority to protect groundwater quantity. In August of 2000, the UW-Madison Department of Urban and Regional Planning issued a report reviewing Wisconsin's high capacity well law and making recommendations for its improvement. The report discusses the potential impacts of high capacity wells on the environment, summarizes the existing law for managing groundwater in Wisconsin, reviews programs in selected states, and discusses issues and strategies for improving groundwater quantity management in Wisconsin. Some of the key recommendations include:

- Expand the public trust doctrine to groundwater

- Enforce existing statutory language regarding groundwater
- Explicitly recognize hydraulic continuity between groundwater and surface water in legislation
- Expand criteria for review and permitting of high capacity wells to consider effects on interconnected surface waters and ecological resources (springs, wetlands, rivers and streams, lakes, fish and wildlife)
- Enforce monitoring and reporting requirements for high capacity well permits
- Encourage voluntary reporting of water use information from other groundwater users
- Address cumulative impacts of wells by ensuring consistency with local or regional water management plans

The report is entitled “Modernizing Wisconsin Groundwater Management: Reforming the High Capacity Well Laws” and is available from the Department of Urban and Regional Planning, UW-Madison/Cooperative Extension, 112-A Old Music Hall, 925 Bascom Mall, Madison, WI 53706 for \$7.00 per copy. (Also available at <http://www.wisc.edu/urpl/people/born/index.html> under "Projects.")

Groundwater quantity was an important topic at the Groundwater Summit held October 30, 2001. Common themes in the afternoon breakout sessions included the need for a statewide management plan for water quantity, water conservation, high capacity well reform, reevaluation of water pricing structures and regional approaches to water quantity issues. At the conclusion of the Summit, 87.5% of those who filled out an evaluation form agreed that there is a need for a statewide groundwater quantity strategy in Wisconsin. 100 per cent of evaluation form respondents agreed that we are not doing enough to protect groundwater quantity in the state.

COORDINATION OF GROUNDWATER MONITORING AND RESEARCH

The GCC provides consistency and coordination among state agencies in funding groundwater monitoring and research to meet state agency needs. Four state agencies have made up to \$750,000 available each year for groundwater-related monitoring or research. Approximately \$11.4 million has been spent through FY 02 on 291 different projects dealing with groundwater or related topics (see Table 3 in Appendix). The sources of money and purposes of monitoring or research include:

1. DNR Management Practice Monitoring - The DNR has had approximately \$300,000 available each year since FY 86 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities that may impact groundwater are conducted. The money comes from the Groundwater Account of the Environmental Fund (which is funded by various fees). Through FY 02, the DNR has spent approximately \$5.4 million on 160 monitoring projects. Several of these projects have been co-funded with DATCP, Commerce and/or UWS.
2. UWS Groundwater Research - The UWS, through its UW-Madison Water Resources Institute (WRI), has received funding since FY 90 for groundwater research. Through FY 02, the UWS has spent \$3.8 million on 107 groundwater research projects. Several projects have been co-funded with DNR, Commerce and/or DATCP and seven were co-funded with WRI through the US Geological Survey.
3. DATCP Pesticide Research - Since 1989, DATCP has had approximately \$125,000 available annually as a result of the pesticide law to fund research on pesticide issues of regulatory importance. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 02, DATCP has spent about \$1.7 million on 42 pesticide projects. Several of these projects have been co-funded with DNR and/or UWS.
4. DILHR/Commerce Private Sewage System Research - The Division of Safety & Buildings (formerly in the Department of Industry, Labor, and Human Relations) received a special GPR appropriation of \$50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology. In 1994,

when the appropriation expired, \$75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 02, DILHR/Commerce has spent approximately \$600,000 on eight projects. Two projects were co-funded with DNR and UWS.

The Joint Solicitation

In 1988, the GCC requested that the UWS create a Groundwater Research Advisory Council (GRAC) to establish a long-range groundwater research plan and develop a groundwater research decision item narrative (DIN) for inclusion in the University's biennial budget. The GRAC consists of university, state agency, and public representatives. During the summer of 1990, the GRAC and GCC developed and endorsed a plan to coordinate the solicitation of projects for funding in FY 92 and subsequent years. The joint solicitation provides for only one submittal of project proposals, rather than four as had been the case. The intent of the joint solicitation is to determine the most appropriate funding source for a particular project.

Statutory language requires that there be agreement between the UWS and the GCC on the use of the UWS research funds before the funds can be released by the Department of Administration. To expedite this agreement, a MOU was signed in 1989 and 1991 by representatives of the GCC, the GRAC, and the UWS on use of the UWS groundwater research funds. The MOU spells out the procedures for establishing priorities and selection of projects for funding of UW groundwater research. The MOU recognizes that the GCC has a substantive role in establishing research priorities and an advisory role in project selection to minimize overlap and duplication. This MOU will be reviewed and updated in FY 03 to reflect current practices and clarify the intent of the monitoring and research funds in light of potential limited budgets in the future.

FY 02 Joint Solicitation. The joint solicitation for FY 02 was distributed in September 2000. A total of 30 project proposals were submitted in response to the joint solicitation. To assist in the review process, a joint meeting of the Monitoring & Data Management and Research Subcommittees of the GCC was held in December 2000 to review and rank the projects that were submitted for funding. As a result of the subcommittee meeting, the GRAC meeting in February, and review of the proposals by agency staff, 21 new projects were selected for funding in FY 02. Eleven on-going projects were carried over into FY 02. A total of 33 projects were funded through the joint solicitation at a cost of approximately \$877,500 (see Table 1).

FY 03 Joint Solicitation. A joint solicitation for project proposals by the UW System, DNR, and DATCP was distributed in September 2001 for funding in FY 03. The joint solicitation package contained a listing of the monitoring and research priorities for each of the agencies, as determined by agency staff, the GRAC, and members of the GCC Monitoring & Data Management and Research Subcommittees (see Appendix). The deadline for proposals was November 19, 2001.

This year, WRI staff members developed a web site that allowed investigators to submit proposals online and reviewers to simply log on to the site to review proposals at their convenience. 38 proposals were submitted, representing 11 institutions or campuses and requesting over \$1 million in funding. A minimum of 3 external peer reviews was solicited for each proposal from experts within the field. GCC Subcommittee members and agency staff also reviewed the proposals and met in January to rank the 38 proposals submitted. In addition, the GRAC met in February to select projects to recommend to the GCC for UWS funding.

Seven of the 38 proposals received will be funded in full or in part through the joint solicitation process. State budget shortfalls severely limited the number of new projects that were selected for funding during FY03. However, with the assistance of Federal (USGS) dollars leveraged through the Water Resources Institute, all of the continuing projects that began in FY 02 will be funded through FY 03. The GCC directed that a letter be sent to the secretary of each of the agencies represented on the GCC asking that funding for groundwater monitoring and research activities be restored in future years (see Appendix). The projects to be funded in FY 03 are listed in Table 2 and online at <http://www.wri.wisc.edu/index.html>.

Distributing Project Results

Final reports are required for each project funded through the Joint Solicitation. Reports from UWS funded projects are kept in the Water Resources Institute Library. DATCP, Commerce, and DNR funded reports are kept on file with the respective agencies, but many are provided to the WRI Library for public distribution as well. All project investigators must submit a 2-page Project Summary upon completion of the final report. These summaries are made available on the WRI web site (<http://www.wri.wisc.edu/wgrmp/wgrmp.htm>). Over 100 summaries are currently provided. Summaries from older reports are printed in *Wisconsin Groundwater Research and Monitoring Project Summaries* (DNR PUBL-WR-423-95 and DNR PUBL-WR-205-90) both of which are available from the WRI Library or the DNR.

Projects funded through the Joint Solicitation have provided valuable information regarding the Wisconsin's groundwater resources, helped evaluate existing regulatory programs, increased the knowledge of the movement of contaminants in the subsurface, and developed new methods for groundwater evaluation and protection. The next section, *Benefits from Monitoring and Research Projects*, highlights some of these projects and illustrates how agencies have used the project results to improve the management of the state's groundwater resources.

Other Coordination Activities

The GCC attempts to compile information about other groundwater research programs within Wisconsin. To this end, groundwater-related research projects funded through the Fertilizer Research Council in FY 01 and 02 are listed in the Appendix. Staff from the GCC, the WFRC, and DATCP met in February of 2002 to discuss ways to identify common research needs, share information about submitted proposals, and communicate research findings. Some preliminary efforts to bring these two processes closer together will be made during the FY 04 Joint Solicitation.

The GCC continues to contact other states with groundwater research programs to prevent research duplication and to make efficient use of limited research funds. The strategy for interstate coordination of groundwater research consists of identifying groundwater research program contacts in each neighboring state and sending each contact information on the GCC, the joint solicitation process, the state groundwater monitoring and research programs, and the project summaries.

Table 1: Groundwater Projects Funded through the Joint Solicitation for FY 02

<i>Agency Title</i>	<i>Author(s)</i>	<i>Affiliation</i>	<i>FY 02 Budget</i>
<i>DATCP</i>			
*Pesticide and nitrate leaching in soils receiving manure	B. Lowery, F. Arriaga, and D. Stoltenberg	UW-Madison	\$18,380
*Effectiveness of phytoremediation and hydrogeologic response at an agricultural chemical facility in Bancroft, WI	W. DeVita and M. Dawson	UW-Stevens Point	\$16,400
Chloroacetanilide and Atrazine Residue Penetration and Accumulation in Two Wisconsin Groundwater Basins	W. DeVita, P. McGinley, and G. Kraft	UW-Stevens Point	\$32,349
Agrochemical Leaching from Sub-optimal, Optimal, and Excessive Manure-N Fertilization of Corn	J. Norman and K. Brye	UW-Madison	\$43,187

The total cost for all projects funded by DATCP in FY 02, including the co-funded projects below is \$135,000.

DNR

*Geologic and geochemical controls on arsenic in groundwater in northeastern Wisconsin	M. Gotkowitz, T. Simo D. Krabbenhoft, M. Schreiber, & R. Hunt	WGNHS, UW-Madison & USGS	\$35,478
*Development of analytical methods for comprehensive chemical and physical speciation of arsenicals in groundwater	J. Aldstadt	UW-Milwaukee	\$31,450
*New approaches to the assessment of microbes in groundwater: application to monitoring bioremediation and detection of pathogens.	M. Collins	UW-Milwaukee	\$37,910
*An analysis of arsenic replacement wells to determine validity of current DNR well construction guidance	K. O'Connor and K. Lauridsen	DNR	\$21,276
*Public health impacts of arsenic contaminated drinking water	L. Knobeloch, L. Hanrahan, H. Anderson, and M. Weisskopf	DFHS	\$28,912
Nitrate Loading History, Fate, and Origin for Two Wisconsin Groundwater Basins	G. Kraft	UW-Stevens Point	\$32,754
Susceptibility of La Crosse Municipal Wells to Enteric Virus Contamination from Surface Water Contributions	R. Hunt and M. Borchardt	USGS & UW-LaCrosse	\$49,704x
Monitoring Contaminant Flux from a Stormwater Infiltration Facility to Groundwater	C. Dunning and R. Bannerman	USGS & DNR	\$22,600x
Preservation and Survival of <i>E. coli</i> in Well Water Samples Submitted for Routine Analyses	W. Sonzogni, J. Standridge, and M. Bussen	WSLH	\$24,990x
Development of a Culture Method for Detection of <i>Helicobacter pylori</i> in Groundwater	W. Sonzogni, J. Standridge, and M. Hamacher	WSLH	\$24,851x
Time Domain Electromagnetic Induction Survey of the Sandstone Aquifer in the Lake Winnebago Area	R. Taylor and J. Jansen	UW-Milwaukee	\$33,530
Delineation of High Salinity Conditions in the Cambro-Ordovician Aquifer of Eastern Wisconsin	T. Grundl and R. Taylor	UW-Milwaukee	\$28,779
Importance of Disinfection on Arsenic Release from Wells	W. Sonzogni, G. Bowman, J. Standridge, and A. Clary	WSLH	\$34,846

DNR/DATCP

Occurrence of Antibiotics in Wastewater Effluents and their Mobility in Soils: A Case Study from Wisconsin	K. G. Karthikeyan and W. Bleam	UW-Madison	DNR \$29,205 DATCP \$16,654
--	--------------------------------	------------	--------------------------------

The total cost for all projects funded by DNR in FY 02, including the co-funded project above is \$436,285.

UWS

*Removal of As(III) and As(V) in Contaminated Groundwater with Thin-film Microporous Oxide Adsorbents	M. A. Anderson	UW-Madison	\$4,500#
*Importance of Groundwater in Production and Transport of Methyl Mercury in Lake Superior Tributaries	D. Armstrong, D. Krabbenhoft, and K. Rolfhus	UW-Madison & USGS	\$3,260#
*A Basin-scale Denitrification Budget for a Nitrate-contaminated Wisconsin Aquifer: A Study at the Groundwater/Surface Water Interface	B. Browne, G. Kraft D. Saad	UW- Stevens Point & USGS	\$18,532#
Co-occurrence and Removal of Arsenic and Iron in Groundwater	P. McGinley	UW-Stevens Point	\$11,120
Field Evaluation of Raingardens as a Method for Enhancing Groundwater Recharge	K. Potter	UW-Madison	\$19,039
Impacts of Land Use and Groundwater Flow on the Temperature of Wisconsin Trout Streams	S. Gaffield and L. Wang	WGNHS	\$33,696
Impacts of Privately-Sewered Subdivisions on Groundwater Quality in Dane County, WI	K. Bradbury	WGNHS	\$39,415
Monitoring and Scaling of Water Quality in the Tomorrow-Waupaca Watershed	H. Lin and B. Browne	UW-Stevens Point	\$35,445
Removal of Heavy Metals and Radionuclides from Soils Using Cationic Surfactant Flushing	C. Evans and Z. Li	UW-Parkside	\$20,849
Investigation of Changing Hydrologic Conditions of the Coon Creek Watershed in the Driftless Area of	R. Hunt	UW-Madison	\$21,619
Effect of Clean and Polluted Groundwater on Reproduction and Development	S. Dodson	UW-Madison	\$22,148
Removal of Arsenic in Groundwater Using Novel Mesoporous Sorbent	J. Park	UW-Madison	\$28,299
Groundwater-Lake Interaction: Response to Climate Change, Vilas County, Wisconsin	M. P. Anderson	UW-Madison	\$20,989

UWS/DATCP

*Remediation of soil and groundwater using effectively and ineffectively nodulated alfalfa.	N. Turyk, B. Shaw M. Russelle	UW-Stevens Point	UWS \$10,785 DATCP \$8,030
---	-------------------------------	------------------	-------------------------------

The total cost for all projects funded by the UWS in FY 02 including the co-funded project above is \$306,311 (including fringe benefits and 6% administration costs).

X partially funded in FY 01

co-funded by U.S.G.S. base funding of WRI

* denotes continuing project from FY 01

Table 2: Groundwater Projects to be Funded through the Joint Solicitation for FY 03

<i>Agency</i>	<i>Title</i>	<i>Author(s)</i>	<i>Affiliation</i>	<i>FY 03 Budget</i>
---------------	--------------	------------------	--------------------	---------------------

DATCP

*Chloroacetanilide and Atrazine Residue Penetration and Accumulation in Two Wisconsin Groundwater Basins	W. DeVita, P. McGinley, and G. Kraft	UW-Stevens Point	\$31,067
*Agrochemical Leaching from Sub-optimal, Optimal, and Excessive Manure-N Fertilization of Corn	J. Norman and K. Brye	UW-Madison	\$35,409

No new projects were funded by DATCP through the FY 03 joint solicitation process.

The total cost for all projects funded by DATCP in FY 03, including the co-funded project below is \$80,000

DNR

*Nitrate Loading History, Fate, and Origin for Two Wisconsin Groundwater Basins	G. Kraft	UW-Stevens Point	\$31,722
*Monitoring Contaminant Flux from a Stormwater Infiltration Facility to Groundwater	C. Dunning and R. Bannerman	USGS & DNR	\$35,000
*Importance of Disinfection on Arsenic Release from Wells	W. Sonzogni, G. Bowman, J. Standridge, and A. Clary	WSLH	\$15,000
Evaluation of Enzyme Linked Immunosorbent Assay for Analysis of Di Amino Atrazine in Wisconsin Groundwater in Comparison to Chromatography	J. Strauss and W. Sonzogni	WSLH	\$11,932

DNR/DATCP

*Occurrence of Antibiotics in Wastewater Effluents and their Mobility in Soils: A Case Study from Wisconsin	K. G. Karthikeyan and W. Bleam	UW-Madison	DNR \$28,476 DATCP \$13,524
---	--------------------------------	------------	--------------------------------

The total cost for all new projects funded by DNR through the FY 03 joint solicitation process, including the co-funded project below is \$17,864.

The total cost for all projects funded by DNR in FY 03, including the co-funded projects is \$128,062.

UWS

*Co-occurrence and Removal of Arsenic and Iron in Groundwater	P. McGinley	UW-Stevens Point	\$17,054
*Field Evaluation of Raingardens as a Method for Enhancing Groundwater Recharge	K. Potter	UW-Madison	\$19,039#
*Impacts of Land Use and Groundwater Flow on the Temperature of Wisconsin Trout Streams	S. Gaffield and L. Wang	WGNHS	\$31,816
*Impacts of Privately-Sewered Subdivisions on Groundwater Quality in Dane County, WI	K. Bradbury	WGNHS	\$17,733
*Monitoring and Scaling of Water Quality in the Tomorrow-Waupaca Watershed	B. Browne	UW-Stevens Point	\$33,387
*Removal of Heavy Metals and Radionuclides from Soils Using Cationic Surfactant Flushing	C. Evans and Z. Li	UW-Parkside	\$21,049
*Removal of Arsenic in Groundwater Using Novel Mesoporous Sorbent	J. Park	UW-Madison	\$28,299#
Role of the Hyporheic Zone in Methylmercury Production and Transport to Lake Superior	D. Armstrong and C. Babiarz	UW-Madison	\$31,620

Determination of Aquitard and Crystalline Bedrock Depth Using Time Domain Electromagnetics	D. Hart and D. Alumbaugh	UW Extension	\$30,330
Monitoring the Effectiveness of Phytoremediation and Hydrogeologic Response at an Agricultural Chemical Facility	W. DeVita and M. Dawson	UW- Stevens Point	\$14,910
F Test for Natural Attenuation in Groundwater: Application on Benzene	F. Evangelista and A. Pelayo	UW-Whitewater	\$12,950
Photocatalytic Adsorption Media and Processes for Enhanced Removal of Arsenic from Groundwaters	M. Anderson	UW-Madison	\$31,116

UWS/DNR

Arsenic Contamination in Southeast Wisconsin: Sources of Arsenic and Mechanisms of Arsenic Release	J. Bahr and M. Gotkowitz	UW-Madison	UWS \$41,831 DNR \$5,932
--	--------------------------	------------	-----------------------------

The total cost for all new projects funded by the UWS through the FY 03 joint solicitation process, including the co-funded project above is \$162,757.

The total cost for all projects funded by the UWS in FY 03 including the co-funded project above is \$303,525 (including fringe benefits and 6% administration costs and excluding USGS co-funding).

funded by U.S.G.S. base funding of WRI

* denotes continuing project from FY 02

BENEFITS FROM MONITORING AND RESEARCH PROJECTS

Table 3 (see Appendix) lists groundwater-related monitoring and research projects funded by state agencies since enactment of Wisconsin's comprehensive groundwater protection legislation (1983 Wisconsin Act 410) in 1984. Those agencies that have funded projects are the DNR, DATCP, DILHR/Commerce, and the UW System. There are 291 projects listed. One hundred eighty-nine of these projects have been funded through the joint solicitation process that began in FY 92. The remaining projects were funded by the above agencies through separate solicitation processes prior to 1992. The table includes the project title, principal investigator or investigators, the years the project was funded, the funding agency or agencies, and the project number if assigned.

Many projects have provided valuable information regarding the state's groundwater resources. Some have helped to evaluate existing regulatory programs and determine if there is a need for additional regulations. Numerous studies have increased the knowledge of the movement of contaminants in the subsurface. . Others have developed new methods for groundwater evaluation and protection. The following discussion highlights some of the areas that have been the focus of research and monitoring projects and illustrates how agencies have used the project results to improve the management of the state's groundwater resources. Citations refer to the projects listed in Table 3.

The Atrazine Rule

The development of the Atrazine Rule (ATCP 30, Wis. Adm. Code) illustrates how the benefits of state-funded research and monitoring can build on one another. In the mid-1980s the corn herbicide atrazine was first detected in monitoring wells and private drinking water wells in Wisconsin. The first systematic well sampling program to characterize atrazine contamination on a statewide basis was the 1988 DATCP Grade A Dairy Farm Well Water Quality Survey (LeMasters, 1989). This state-funded well survey estimated that atrazine was present in 12% of the Grade A Dairy Farm Wells in the State.

This study left unanswered many questions regarding the sources, groundwater susceptibility, and the presence of pesticides other than atrazine. Without better information on these and other questions, it was challenging for DATCP, the agency charged with groundwater protection related to agricultural chemicals, to develop a plan of action. It was obvious that a concerted information gathering program was needed. Over the next several years, before and during the development of the DATCP atrazine rule, the Wisconsin Groundwater and Pesticide Research Program played an essential role in providing the needed information. Research and monitoring were conducted on several topics that played a direct role in the evolution of the atrazine rule.

The state research and monitoring program funded several key projects to better understand the sources of atrazine contamination. When atrazine was first found in groundwater, an argument had been made that this was the result of point sources such as spills and mishandling. One of the most important findings that allowed DATCP to begin developing the atrazine rule was that normal agricultural applications of atrazine could lead to groundwater contamination. The DATCP groundwater monitoring project for pesticides (Postle, 1986-96) used monitoring wells located next to agricultural fields to study groundwater contamination by atrazine and other pesticides. This study showed that atrazine from field use on sandy soils could cause contamination, often above the 3 µg/L ES. The UW Water Resources Center conducted a detailed hydrogeologic study (Chesters, 1990-91) at a farm in Dane County and showed conclusively that atrazine contamination could result from both field applications and mixing/loading practices. With the knowledge that nonpoint contamination of groundwater by atrazine was indeed occurring, DATCP could develop ways to reduce this contamination.

State-funded research was essential in showing that atrazine contamination did not follow simplistic notions of groundwater contamination susceptibility. One of the most important findings was that the Central Sands and the Lower Wisconsin River Valley (LWRV), two areas that appear similar in soils and agricultural practices, had significantly different susceptibility to contamination. These differences were pointed out in several research projects conducted by the UW Soil Science Department (Daniel, 1991; Lowery, 1991; McSweeney, 1991; Lowery,

1992-3). This information had a direct influence on the atrazine rule in that there is now a use prohibition in the LWRV and managed use in the Central Sands.

Another key finding related to the susceptibility of groundwater to atrazine contamination was that many of the areas with high frequency of detections had medium textured (loamy) soils. It had previously been thought that these areas were less susceptible to leaching and groundwater contamination than areas with sandy soils. State-funded research and monitoring efforts, however, showed that the intensity of atrazine use, in addition to soil and geologic conditions, played an important role in the contamination. This finding helped to explain why many areas in south central Wisconsin, with medium textured soil and high corn production, had many wells contaminated with atrazine. This knowledge allowed DATCP to adopt management strategies for reducing atrazine contamination in these areas.

When atrazine was first discovered in Wisconsin's groundwater in the mid-1980s, DATCP was interested in managing its use based on predictive modeling of contamination processes. Modeling activities funded by the state research program, however, indicated that the behavior of atrazine and other contaminants in the environment was complex and could not be reliably predicted by modeling. In response to this finding, DATCP adopted a more empirical approach to identifying management areas. Actual well results were plotted on maps and, together with an analysis of soils and geology, management areas were delineated.

When monitoring and rule making efforts for atrazine first started, parent atrazine was the only compound that was considered. As more research was conducted, however, it was discovered that three metabolites (breakdown products) of atrazine were present in groundwater and were of health concern (Chesters, 1990-91; LeMasters, 1990; Cowell, 1990; Cates, 1991). State-funded sampling programs showed that due to the presence of atrazine metabolites, the groundwater problems were more serious than previously considered. This knowledge allowed DNR to strengthen the groundwater standard for atrazine in 1992 and allowed DATCP to strengthen the atrazine rule in 1993 and extend required use reductions to the entire state.

It is interesting to try to envision how DATCP's atrazine rule would look if it did not have the benefit of the intensive research and monitoring efforts. It is safe to say that it would not have been developed on as good an understanding of the behavior of atrazine in the environment or the geographic patterns of contamination. It is possible that without the intensive monitoring efforts, the full extent of the problem would not have been discovered and atrazine use would not have been reduced. On the other hand, it is possible that with inadequate knowledge a "broad brush" approach would have been taken. This could have resulted in unfair regulations that were not tailored to the different geographic areas of the state.

Two important aspects of environmental regulation that promote its acceptance are that it is based on science and that it is fair. Good research is necessary to achieve these two characteristics. The Atrazine Rule has experienced a relatively high degree of acceptance due to the effort that was put into its development.

Groundwater Monitoring at Solid Waste Disposal Sites

The DNR's Solid Waste Management (SWM) program received project funding eight times from 1985 to 1995 through the joint solicitation process. These projects have benefited the program in many ways, primarily impacting regulations and monitoring practices.

The first two studies (Friedman, 1985-87; Battista, 1988-89) revealed for the first time that groundwater around many Wisconsin landfills was contaminated by VOCs. The studies also showed that VOC contamination of groundwater was more common at unlined municipal solid waste landfills than at other types of landfills. A follow-up VOC study (Connelly 1993-94) showed that VOC levels have decreased at most of the unlined landfills, though at many of the sites VOC levels do not show continued decline. There was no VOC contamination definitely attributable to leachate migration at any of the older, engineered landfills that confirmed that these sites are performing as SWM program staff had hoped. The results of the three VOC studies have been used to establish requirements for VOC sampling at new and existing landfills. These studies have also indicated that inorganic

compounds could be useful in predicting VOC contamination at landfills. Therefore, until recent EPA rules required VOC monitoring, the SWM program allowed sites to sample for inorganic parameters as part of routine monitoring and not sample VOCs until inorganics were elevated. The VOC studies provided valuable data that was used to convince EPA to reduce the number of VOCs required for monitoring at municipal solid waste landfills in Wisconsin. This reduction in monitoring (the use of inorganics and the reduced number of VOCs when they are required) allowed landfill owners considerable cost savings while maintaining equivalent environmental protection. Additionally, the VOC data was used to require responsible parties to define the degree and extent of contamination and remediate groundwater contamination at their landfills.

Research on methods of assessing groundwater quality data and data quality control completed in the third VOC study has been helpful to SWM program staff and consultants in interpreting groundwater quality data from landfills and other facilities. This study also showed the need to require laboratories to report data between the limit of detection and the limit of quantitation.

An assessment of Wisconsin's Groundwater Monitoring Plan program (Pugh, 1992) for active non-approved landfills provided the documentation of a set procedure for selecting monitoring sites. This information has been useful in recent meetings with municipalities held to convince municipalities that they have not been singled out for further evaluation of groundwater contamination and to demonstrate that the process used for selecting landfills for monitoring is objective.

Three studies from 1991 to 1994 on the potential groundwater impacts at deer pits, yard waste sites, and construction and demolition landfills (Pugh, 1992-3; Pugh, 1994) were conducted because little or no data existed on the potential impact to groundwater from these sites. Research has provided the information necessary to revise rules and establish policy regarding monitoring and siting of construction and demolition (C/D) landfills, deer pits, and yard waste sites in Wisconsin. The groundwater study of deer pits showed that impacts were minimal and helped the SWM program to decide not to require liners and to loosen some construction and reporting requirements. Similarly, the yard waste site study showed only minor groundwater impacts, which led the SWM program to encourage active management of these sites rather than stiffen regulations. The study of construction and demolition landfills showed some groundwater impacts at large sites but little or no impacts at smaller sites. These findings led to new regulations (effective June 1996) allowing lined intermediate size C/D landfills, which can provide the economic benefits of a large site without the potential negative impacts of very large sites. Based on the research, the regulations were written to require groundwater monitoring of inorganic parameters at small size C/D landfills but only require VOC sampling when establishing background. Since these studies have been conducted, many states and the EPA have contacted the SWM program about the information collected.

A more recent DNR-funded study undertaken by the SWM program (Connelly, 1994) was a comparison of groundwater sampling methods for collecting metals samples at monitoring wells. The study was in response to EPA's October 1991 ban on field filtering of groundwater samples that became effective in October 1994. The SWM program opposed this ban because many Wisconsin monitoring wells produce very turbid water which can lead to false positive results for metals if samples are not filtered. Additionally, the new EPA-recommended procedure, low-flow pumping, requires a significant amount of additional equipment. The study showed that the low-flow pumping method was appropriate in many circumstances but could not be used to sample slowly recovering wells. The results showed that turbidity was the best indicator that a well has been sufficiently purged. The results of the investigation are being used to revise groundwater sampling procedures required by the SWM program. Additionally, the study helped establish Wisconsin as one of two leading states playing a major role in advising EPA on revisions to their groundwater sampling requirements at municipal solid waste landfills.

A follow up study by the SWM program (Svavarsson, 1995) compared low flow pumping and bailing for VOC groundwater sampling at landfills. The study indicated that, in contrast to what some were claiming, there was very little difference in the results when using the two different methods. These findings were incorporated into the new groundwater sampling code and allowed the use of either method for sampling VOCs. This reduced the cost that landfill owners would otherwise have had to bear to purchase and operate low flow pumping equipment.

Monitoring for Naturally Occurring Compounds (e.g. Arsenic)

Wisconsin is also a leader in groundwater monitoring for naturally occurring compounds. Two projects in the DNR Lake Michigan District (Stoll, 1992; 1994) identified the existence of lead and arsenic contamination in groundwater. Homeowners were alerted through direct mailings, public meetings and mass media news releases. Over 72,000 people were unaware of their exposure to the substances in their drinking water. In one case, the sources of metals in these drinking water supplies were given priority for removal (Door County Lead Arsenate Mixing Sites). In an Arsenic Advisory Area (AAA), well construction criteria were defined to avoid arsenic associated with a mineralized zone located at the contact between the St. Peter Sandstone and the Galena-Platteville Dolomite. The DNR coordinated with the DHFS to conduct health surveys on individuals consuming locally contaminated water supplies and made appropriate health recommendations. Local County Health Departments in affected areas are also actively monitoring groundwater quality and are providing assistance to homeowners. In FY 01 and FY 02, DHFS staff (Knobeloch 2001) received additional funding to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR staff, town clerks and others have conducted well sampling campaigns in townships in the affected counties.

Ongoing research indicates that casing off the upper parts of the St. Peter Sandstone is usually effective in eliminating or reducing the presence of arsenic in drinking water. DNR guidance recommends the installation of 80 feet of casing through the sandstone contact for drinking water wells in the AAA. However, in an effort to save costs, the majority of wells constructed are not following the recommendations. Over the last several years, some wells that were not constructed according to guidance have exhibited increasing arsenic concentrations over time and have required replacement or reconstruction. In addition, follow-up testing on 50 replacement wells found that arsenic levels are exceeding standards in at least 5 cases where initially they had been below. Additional sampling of replacement wells occurred in FY 01 and 02 to test whether current guidelines are adequate at lowering arsenic concentrations (O'Connor 2001).

In FY 02 the WGNHS completed field experiments in the Fox River Valley that evaluated mechanisms of arsenic release to groundwater from domestic wells completed in the St. Peter sandstone aquifer, including studies of arsenic exposure to residents in the area and the effects of well chlorination on arsenic levels (Gotkowitz 2001). Results of this study were presented to DNR Drinking Water and Groundwater Program staff and used by the DNR to develop well construction guidelines for the Towns of Algoma and Omro.

Several other ongoing projects addressing arsenic issues include a study refining analytical methods for detection of arsenic compounds (Aldstadt 2001), a study of the role of chlorination in releasing arsenic (Sonzogni 2002), three projects investigating treatment methodologies for both private and public water supplies (Anderson 2001, Park 2002, McGinley 2002), and a new project investigating the occurrence of arsenic in southeastern Wisconsin aquifers (Gotkowitz 2003). These studies will help provide needed information about the occurrence, health risks, and remediation of arsenic in drinking water supplies. Results will be made available as final reports are completed.

Groundwater Movement in Fractured Dolomite

Door County has been the site of four research projects by the WGNHS to develop a framework for studying the complex groundwater flow regime in fractured rock found in many parts of the state. The first project (Bradbury, 1986-90) started as a nonpoint source watershed project investigating the hydrogeology and groundwater geochemistry in the shallow fractured dolomite aquifer in Door County. Groundwater quality was found to vary widely over time with bacteriological contamination common. The second study (Bradbury, 1992) showed that modeling results obtained from a discrete fracture model varied considerably from results produced by a continuum model for groundwater movement. The discrete fracture model estimated capture zones, groundwater flow paths, and groundwater travel times by using mathematical representations of fractures digitized from aerial photos. The third study (Bradbury, 1993-94) used a tracer for characterization of groundwater movement and contaminant transport. It revealed that hydraulic conductivity can vary widely in the same well depending on what depth interval

is tested.

A fourth study applied the discrete fracture flow model above to wellhead protection at the City of Sturgeon Bay (Bradbury 1996). Municipal wells at Sturgeon Bay draw groundwater from a series of horizontal fracture planes in Door County's dolomite aquifer, and delineating wellhead protection areas in such environments is extremely challenging. This complex project has required hydrogeologic information and analytical tools developed through the three Door County groundwater research projects above which targeted processes and models for groundwater movement in fractured rocks. Without the knowledge and experience gained through these previous projects the Sturgeon Bay Wellhead Protection Project could not have been accomplished.

During 1999, Bradbury and others began a follow-up project to attempt to verify the results of the Sturgeon Bay wellhead protection project using natural groundwater tracers (Bradbury 2000). This research is measuring the natural seasonal variations in temperature, electrical conductivity, and oxygen and hydrogen isotopes of groundwater and precipitation in order to verify the sources and velocities of groundwater moving toward Sturgeon Bay's wells. The use of such tracers is attractive because they are naturally present in the environment.

Developing New Tools for Groundwater Protection

Applications of a wide variety of tools for gathering and working with hydrogeologic and groundwater quality data have been funded. Projects involving one of the most promising tools in environmental management, Geographic Information Systems (GIS), have been funded in the DNR's Northeast Region (NER) and in Dane County. The funding agencies hope to continue to develop improved methodologies to make groundwater quality and contaminant source data more readily available.

Geographic information management in DNR's Northeast Region. An environmental inventory utilizing GIS was created in the DNR's former Lake Michigan District (Carlson, 1992-93; Stoll, 1994). Computerized maps were created which link all potential groundwater impact site locations with their respective data. This project has resulted in numerous map products showing potential groundwater contamination source/receptor relationships in a rapidly retrievable, highly summarized fashion. Many consultants, county agencies, state agencies and realtors have utilized this information for environmental management and land transactions. The chief benefits to the public have been the rapidly accessible information and greater purchasing confidence when buying property. Landowners also experience increased responsibility for the land they reside on, as they become aware of how readily available this information is. In this way, use of GIS has heightened awareness of the importance of wise land use.

A subsequent project gathered relevant geologic and hydrogeologic data from case files and entered them into one single relational database (Stoll, 1996-97). This database is joined in a GIS with the previously located site information. This combination provides an easily accessible wealth of information that can be used for queries and analysis. In addition, a program was developed utilizing Environmental Systems Research Institute (ESRI) Avenue for ArcView language to query data the DNR Region has gathered. For instance well driller construction logs which are in a File Maker Pro software database are linked in an ArcView Project to be readily viewed by selecting an area on screen. Also, summary reports can be prepared of local conditions prior to investigating contamination sites in the field by selecting an area on screen.

GIS work conducted in NER has provided the seed for the growth of GIS and GPS source and receptor locational work statewide. In 1998, NER mapped the location of over 2000 public water supply wells utilizing GPS methods with differential correction. From that work, wellhead vulnerability radii are assigned to each well to provide the basis for Wellhead Vulnerability determinations relative to that well and its local potential contaminant sources.

Regional groundwater models. Previous support of county-wide groundwater inventory studies and of modeling methodologies (Potter, 1992-93; Anderson, 1997) has given WGNHS and USGS personnel the hydrogeologic databases and analytical tools needed for the construction of regional groundwater models such as the recently completed Dane County groundwater model. This computer model, which covers all of Dane County, simulates current and future groundwater conditions and is being used to evaluate how current and future groundwater

pumping affects regional water levels and also how groundwater use affects shallow lakes, streams, and wetlands. In addition, this model has been used to delineate groundwater capture zones for all municipal wells in Dane County (Bradbury 1996).

The Dane County model, which provides a modern hydrogeologic framework for groundwater movement in Dane County, has stimulated a number of significant research projects by other investigators (Mickelson 1994-95; Bradbury et al., 2000). These investigators are using the model as a starting point for more detailed flow models of specific problems or areas of the county. One of the most significant of these is the award of a multi-year USEPA STAR grant to a team of DNR, UW-Madison, USGS, and WGNHS investigators who are investigating the water-resources impact of different land-use strategies on Madison's urban fringe. This research will support several graduate students and will provide an integrated assessment of the hydrological, ecological, and institutional impacts of urbanization and land-use change. This research is focused on the Pheasant Branch watershed just west of Madison. Other research projects are investigating the sources of groundwater supplying important springs in the Nine Springs and Token Creek watersheds, with the goal of determining how nearby development and groundwater use could affect the springs.

The Dane County model has now become a prototype for regional groundwater models in other parts of Wisconsin. In FY 00 the WGNHS, USGS, and SEWRPC began a cooperative project to develop a similar model for the entire seven-county SEWRPC area of southeast Wisconsin. Other modeling projects are taking place in Sauk, Rock, and La Crosse Counties. Such models are critical tools in the planning process, and allow water managers to evaluate the impacts of various future water management and land use alternatives in order to make well-informed land-use decisions.

Prevention and Remediation of Groundwater Contamination

The State of Wisconsin (through the UWS Water Resources Institute) has supported twenty-four research projects emphasizing new technologies for prevention or remediation of groundwater contamination. Many of these projects have been completed. Final technical reports are published or in press. The reports and studies in progress provide information or products that will be important for future efforts aimed at controlling or attenuating groundwater contamination in Wisconsin. The findings cover a wide range of technologies including:

- New and enhanced physicochemical or biological methods to renovate waters contaminated by pesticides and volatile organic carbon compounds (Li, 2000), (Benson and Eykholt, 2000), (Benson, 1997-2000), (Hoopes, 1997-99), (Park, 1997-98), (Collins, 1997-98), (Bahr, 1996-98), (Hickey, 1994-96), (Anderson, 1994-95), (Chesters and Harkin, 1991), (Harris and Hickey, 1991-92);
- Enhancements in the ability to control, monitor, and predict the movement of landfill and mine waste contaminants to groundwater (Edil and Benson, 2000), (Edil 1997), (Benson, 1995-96), (Edil and Park, 1992-93);
- Improvements in the predictability of pump-and-treat remediation applications to contaminated aquifers (Bahr, 1994-95);
- Innovative agricultural practices designed to reduce groundwater contamination by pesticides and nitrate (Bundy, 1993-94, 1997-98), (Shinners, 1995-96), (Newenhouse, 1995), (Harrison, 1992-93), (Bahr, 1991-92); and
- Development of new technologies for evaluating the integrity of water supply well and exploration borehole seals (Edil, 1996, 1998-99), (Edil and Benson, 1997-98).

Biological Effects of Groundwater Contaminants

The GCC has solicited research projects during the last several years that deal with biological aspects of groundwater contamination.

Several projects have focused on developing new techniques for detecting, quantifying, and monitoring microorganisms in groundwater and soils. Researchers at the UW-Madison Soil Science Department, developed a

rapid molecular method using the polymerase chain reaction (PCR) to assay soils for the presence of specific sewage-borne pathogens (Hickey 1997). PCR-based methods eliminate the need to culture organisms for detection, and remedy shortcomings of traditional techniques by allowing rapid, sensitive, and specific identification of the pathogens of concern rather than indicator organisms. The PCR protocol Hickey developed was designed to detect DNA originating from *Escherichia coli*, which is one of the major species of bacteria associated with human waste. With this method he could distinguish *E. coli* DNA from that of its closest relative, *Shigella*. The method allowed the detection of DNA equivalent to about 20 cells. Currently, he is testing the PCR method for tracking of *E. coli* in the environment.

Because they have the capacity to co-metabolize a wide variety of organic chemicals, including halogenated compounds, methanotrophic bacteria have significant potential for bioremediation. The UW-Milwaukee Department of Biological Sciences has developed methods for quantification of methanotrophs in groundwater (Collins 1997, 1999). These methods, that include competitive PCR and direct PCR, will provide approaches to monitoring bioremediation and natural attenuation. In addition, this work has provided the basis of another study that applied direct PCR to the detection of pathogens in groundwater (Collins 2001). This project will be completed in FY 03.

The Marshfield Medical Research Foundation has investigated the association of pathogenic viruses and bacteria in private wells with incidences of infectious diarrhea and indicators of well water contamination (Borchardt 1997, 1999). In general, infectious diarrhea was not associated with drinking from private wells, nor was it associated with drinking from wells positive for total coliform. However, wells positive for enterococci were associated with children having diarrhea of unknown etiology, which was likely caused by Norwalk-like viruses. Final results indicate that the incidence of virus contamination in private wells is lower than that of community wells, but still may affect 4-12% of private wells.

The UW-Madison Department of Wildlife Ecology recently completed a study of the possible relationship between common agricultural chemicals and Wisconsin's declining and endangered amphibian population (Karasov, 1998). The researchers tested the effects of atrazine and nitrate on northern leopard frog (*Rana pipiens*) larvae in the laboratory. Neither atrazine, nor nitrate, nor their interaction had a significant effect on development rate, percent metamorphosis, time to metamorphosis, percent survival, mass at metamorphosis, or hematocrit. Nitrate slowed growth of larvae; however, this growth inhibition was not thought to be biologically important when compared to natural variation in the environment. Thus, the authors concluded that concentrations of atrazine and nitrate commonly found in the environment do not appear to pose a significant threat to *R. pipiens* larvae through direct toxicity.

Researchers at UW-Stevens Point College of Natural Resources studied the acute and chronic toxicity of nitrate to brook trout embryos and larvae (Crunkilton, 1999). Exposure to nitrate at environmentally realistic concentrations increased mortality in brook trout embryos and reduced growth or biomass in long-term exposures. The lowest observable effect concentration was 6.25 mg/L NO₃-N for both mortality and growth of feral brook trout. Mortality was greater in soft water compared to hard water and the effect was independent of nitrate concentration. These findings suggest that high nitrate concentrations may increase mortality of brook trout embryos in coldwater streams with significant groundwater baseflow in agricultural areas.

GROUNDWATER DATA MANAGEMENT

Department of Natural Resources

Collection and coordination of groundwater data exchange within the DNR and with outside agencies continues to be a high priority. The Department continues its focus on the collection and retrieval of groundwater data to meet inter-agency responsibilities and cooperative agreements.

The Department's groundwater data system, the Groundwater Retrieval Network (GRN), continues to provide access to well and sample data through its web interface, available at <http://www.dnr.state.wi.us/org/water/dwg/>. GRN currently accesses information from over 276,600 wells. These wells represent public and private water supply wells, piezometers, monitoring wells, non-potable wells, and groundwater extraction wells from three program systems in the bureaus of Waste Management and Drinking Water and Groundwater. Enhancements to the GRN system, suggested by regional and central office staff as well as external partners, are implemented through a yearly process allocating available groundwater related programming hours. These programming hours are used to improve system functionality and ease of use.

A new program is being finalized that maintains an updated GRN locational coordinate and updates a statewide Geographic Information System (GIS) coverage of well locations, maintained through a link with GRN. GRN allows users to extract well and sample information in Microsoft Excel format, comma or tab delimited text format. Using ArcView (a desktop GIS software package) GRN data can then be imported to create a well GIS "layer" on a personal computer for viewing and querying purposes.

Several enhancements of data systems related to the DNR Well Forms software program were completed to allow uploading electronic information from the Monitoring Well Construction and Monitoring Well Development forms. Consultants and drillers have the ability to submit their information in an electronic format to the Department and that information can now be uploaded to our existing system.

The Bureau for Remediation and Redevelopment (RR) Program continues to work on the development of its GIS Registry System. The existing application is intended to be converted to ESRI's software product, ARCIMS, so that the programming and other maintenance tasks can be accomplished more quickly and at a lower cost. RR also intends to develop a registry web site for soil contaminated sites. In addition to the ongoing efforts, work continues on quality assurance and quality control (QAQC) of existing data.

As of July 1, 2002, the Bureau of Waste Management only accepts electronic submittal (via diskette) of environmental monitoring data from landfill owners, labs and consultants (landfill owners with less than 10 wells were granted an exemption from electronic submittal until this year). Establishment of electronic signature standards from DOA continues to delay progress in implementing a pilot program to allow facilities to submit environmental monitoring data via e-mail. The Bureau is continuing to look at options to provide a web interface to allow facilities to upload environmental monitoring data into the Groundwater and Environmental Monitoring System (GEMS) database and review the data currently in GEMS.

The Bureau of Watershed Management has implemented a database, designated the System for Wastewater Applications, Monitoring, and Permits (SWAMP). This database system stores facility specific information such as address, contacts, location, permit requirements, monitoring results, and violations of permit requirements for private and municipal wastewater treatment facilities. Data for holders of specific Wisconsin Pollutant Discharge Elimination System (WPDES) and general permits are stored. The system contains current information on groundwater, wastewater, and biosolids treatment/management. Historical sampling data from groundwater monitoring wells is available through the system and current sample results are added on a monthly basis. Sampling results and site loading information are also available for land application of municipal sludge, septage and industrial sludge, by-product solids and wastewater.

The State's Source Water Assessment Program continued to make progress on several groundwater-related data initiatives in FY 02. The DNR's Drinking Water and Groundwater program coordinated efforts to improve the Department's data on public water supply wells and significant potential sources of contamination that may threaten these wells. Cooperative projects with the Remediation and Redevelopment, Waste Management, and Watershed Management programs are improving existing locational information and collecting new information for known groundwater contamination sites, large landfills, large confined animal feedlot operations and other potential threats. Additionally the WGNHS and DNR continue to improve their searchable index of scanned images of more than 350,000 well construction reports. DNR staff use these reports to help determine the susceptibility of public water systems to contamination and for many other purposes.

Department of Agriculture, Trade and Consumer Protection

DATCP needs up-to-date, reliable data about pesticide and nitrate-N contamination of groundwater. DATCP uses these data to develop substance specific rules about pesticide use, such as DATCP's "Pesticide Product Restrictions" (Chapter ATPC 30, Wis. Adm. Code), to respond to citizen requests on groundwater quality data for specific locations, and to initiate timely investigations of pesticide contamination of groundwater. DATCP ensures the quality of its database by carefully checking and cross-referencing paper lab slips and computerized data received from DNR, DATCP's laboratory, and other sources. This scrutiny is important, because DATCP uses these data for regulatory purposes. DATCP also works closely with other local and state agencies to coordinate groundwater data collection and to improve the integrity of groundwater data in Wisconsin.

DATCP maintains two groundwater sample databases: the *Drinking Water Well System* and the *Monitoring Well System*. The *Drinking Water Well System* contains contact and location information, well characteristics, and pesticide and nitrate sample results for private and public drinking water wells. The *Monitoring Well System* contains similar information for monitoring wells, and also tracks specific pesticide use history, soils, crop history, well construction, and precipitation and irrigation at monitored sites.

DATCP's *Drinking Water Well System* currently contains information for over 37,000 wells and over 217,000 pesticide and nitrate-N results. These data represent samples analyzed by DATCP, SLOH, and other public and private laboratories. The *Drinking Water Well System* was converted from a Paradox to Access97/SQL Server application in FY 99 to: (1) meet state database and operating system (Windows NT) standards, (2) improve compatibility of data with other established database systems, and (3) begin improving links between these databases and our geographic information system (GIS) tools. The *Monitoring Well System* will be converted to Access97/SQL Server in FY 02. Members of DATCP's Groundwater Protection Unit and its Containment and Remediation Unit access the database.

DATCP uses geographic information system (GIS) tools to analyze groundwater data and prepare maps for public hearings, DATCP board meetings, presentations, and other uses. DATCP prepares and maintains ArcInfo and ArcView data layers of well locations, atrazine concentrations, atrazine prohibition areas, and other pesticide and nitrate-N data. These GIS layers and associated database information are used to generate maps of statewide pesticide and nitrate-N detections in wells, as well as maps for chapter ATPC 30, Wis. Adm. Code (the "Atrazine Rule"). Other GIS analyses involve identifying groundwater wells that may be impacted by point sources of pesticide and nitrate-N contamination. DATCP also uses global positioning system (GPS) receivers to locate and map wells and other features, such as agrichemical facilities and spill sites, that may affect groundwater quality.

Wisconsin Geological and Natural History Survey

The Wisconsin Geological and Natural History Survey, a part of the University of Wisconsin-Extension, has the responsibility for geologic mapping, collection, and analysis of basic data, and survey and research on Wisconsin's groundwater resources. Products from the Survey geologic mapping program support land-use planning and groundwater-quality management and protection. County-wide inventories of groundwater resources are supported through cooperative agreements with county governments. Through analysis and integration of data from subsurface records and water-quality sampling programs, these studies result in water-table elevation maps and other products, providing planners and educators with a good foundation of information for groundwater-quality management and protection. Detailed research and monitoring of groundwater movement and quality are undertaken on a project basis. Maps, publications, and presentations are developed for groundwater education and outreach.

Computerized groundwater databases, including geographic information systems (GIS) data, continue to be developed at the Survey, usually on a project basis to assist with on-going research. The effort to integrate, standardize, and document our data holdings continues to be a priority at the WGNHS. Another high priority is to make high quality, accurate digital datasets available to state agencies and the public.

Department of Commerce

Commerce is continuing its data integration information technology initiative. With regard to groundwater protection, Commerce maintains databases of underground petroleum storage tank systems and properties with petroleum contamination either in the past or currently. The database also stores information on activities associated with onsite sewage system design, installation and maintenance. The department is studying whether Sanitary Permit information collected by the governmental units (counties) may be integrated with information on onsite system servicing, maintenance and inspection activities that are required to be reported and tracked. The goal is to reduce or eliminate duplicative records kept by the governmental units and the department.

University of Wisconsin System

The Central Wisconsin Groundwater Center maintains a database of private well testing data from the Environmental Task Force Regional Laboratory at UW-Stevens Point, and Drinking Water Education Programs conducted through the Center. There are currently over 344,000 individual test results for approximately 49,100 samples covering the state. Chemistry data includes pH, conductivity, alkalinity, total hardness, nitrate-nitrite, chloride, saturation index, and coliform bacteria. In 1998, a new sampling program for iron, sodium, potassium, copper, lead, calcium, magnesium, manganese, zinc, and triazine was also initiated. Arsenic and sulfate were added late in 1999. The database primarily covers the period 1985 to the present. The database is PC-based and can be easily queried to be a significant source of information for local communities and groundwater managers. Forty-three counties are represented by 100 or more samples in the databases, and 23 counties are represented by 500 or more samples.

Department of Transportation

The DOT has entered salt storage facility records into a new database. There are currently 1,193 salt storage “sites” listed in the database and 2,212 “sub-sites” or storage facilities including salt storage sheds, liquid storage containers, and salt storage piles at docks. Detailed inventories of salt use are kept by each county and updated monthly. A record of facility inventories, inspections, repairs and improvements is included in the database.

The DOT maintains records of hazardous material investigation and remediation for highway projects. These records include information regarding groundwater contamination and groundwater use restrictions.

Groundwater monitoring is also performed for several DOT wetland mitigation projects. These records contain information on groundwater elevation and gradients as it relates to a wetland restoration or creation project (surface water and groundwater interaction).

The Wetland Mitigation Bank Accounting System is maintained by DOT on Wetland Bank activity. This system provides information on wetland loss and compensation by acres and wetland type and by project and location.

Department of Health and Family Services

DHFS does not maintain a centralized database on groundwater data. The Department relies on other state agencies for computerized groundwater information.

DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION

PRIORITY RESEARCH & MONITORING ISSUES

- **Investigate adverse impacts from groundwater withdrawals:** In FY 97, DNR staff with help from a Groundwater Quantity Technical Advisory Committee completed a report on the status of groundwater quantity in Wisconsin (see "Condition of the Resource - Groundwater Quantity"). The report identifies localized areas with groundwater quantity problems and discussed the effects of groundwater withdrawals on surface waters and long-term groundwater availability. There is a need to further quantify hydrographic relationships of surface and groundwater. The GCC should continue to encourage research efforts that will provide information useful in addressing this issue.
- **Investigate adverse impacts of naturally occurring substances in groundwater:** Continued problems of elevated arsenic, low pH, and other water quality problems in domestic wells exist over large areas of northeast Wisconsin. Additionally elevated sulfate and total dissolved solids have been found in some new deep municipal wells in the Lower Fox River Valley making the wells unusable. In some other existing deep wells as far south as Milwaukee the total dissolved solids have been steadily increasing over the years. These sulfate and TDS levels pose a problem for local water managers, and the origin of the dissolved solids is not completely understood. The State needs more information about the extent and causes of these problems in order to give advice to homeowners, municipalities, and well drilling contractors. The GCC should continue to encourage research efforts that will provide information useful in addressing these issues.
- **Evaluate occurrence of recently discovered groundwater contaminants:** Recent research conducted in Europe and the U.S. indicates that traces of pharmaceuticals (including antibiotics and hormones) and pesticide breakdown products are common contaminants found in groundwater and surface water. Current testing methods do not allow adequate detection of these possible contaminants. Research is needed to determine whether these substances pose a threat to Wisconsin's groundwater resource.
- **Research land use management and its impact on the groundwater resource:** Additional research is needed on the effect of various land uses (e.g. urbanization) on groundwater quality and quantity. Several projects that study the impacts of land use on groundwater have been and continue to be funded through the joint solicitation. These projects must be managed in such a way as to maximize their relevance to state land use problems. This issue crosses agency lines and promises to be an important issue for years to come.

PRIORITY POLICY & PLANNING ISSUES

- **Address groundwater quantity issues at both statewide and regional levels:** Groundwater quantity was an important topic at the Groundwater Summit held October 30, 2001. Common themes in the afternoon breakout sessions included the need for a statewide management plan for water quantity, water conservation, high capacity well reform, reevaluation of water pricing structures and regional approaches to water quantity issues. At the conclusion of the Summit, 87.5% of those who filled out an evaluation form agreed that there is a need for a statewide groundwater quantity strategy in Wisconsin. 100 per cent of evaluation form respondents agreed that we are not doing enough to protect groundwater quantity in the state. The GCC will continue to be active on this issue and facilitate further dialogue among all parties on potential approaches and solutions.
- **Provide resources to local governments for Smart Growth/Comprehensive Planning activities.** Recent legislation has required local units of government to develop a comprehensive plan by 2010 in order to undertake land use activities. This plan must address 9 elements, including natural and agricultural resources, housing, utilities, and land use. This planning process presents a unique opportunity to address and implement

groundwater protection at the local level. The GCC will seek ways to assist local communities in their planning efforts to encourage groundwater protection. The Local Government Subcommittee will play an active role in this effort.

- **Find solutions to groundwater nonpoint pollution problems:** A 2002 DATCP report indicates that 37.7% of wells contain a detectable level of at least one herbicide or herbicide metabolite and 11.1% of Wisconsin's wells still contain detectable atrazine residues. In addition, 14% exceed the nitrate standard. These rates are substantially higher in agricultural areas. More work is needed to determine how far Wisconsin groundwater will deteriorate without a substantial change in farming practices, and what practices will sustain both agriculture and groundwater quality. The GCC will support the agencies and the UWS in obtaining information pertinent to the human health implications of consuming nitrate contaminated groundwater and the effect of discharge of this groundwater on surface waters and their ecosystems. In addition, it will continue to facilitate consistent education to provide a clear message on the many causes and effects of nitrate in groundwater for urban and rural citizens.
- **Identify tools that can be used to better predict Wisconsin's groundwater susceptibility to contamination:** Studies have demonstrated the need for developing statewide data layers that would facilitate better groundwater vulnerability assessments. These data layers include land use, soils, regional groundwater flow, hydrogeologic characteristics such as aquifer materials, and potential point sources of contamination such as underground storage tanks and pesticide spills. The studies also illustrate the importance of locational data for contaminant sources. The GCC's Planning & Mapping and Monitoring & Data Management Subcommittees have prioritized, promoted, and helped facilitate the development of data layers as part of a larger data integration initiative. Through the DNR's Source Water Assessment Program, which will be implemented in 2003, this work will continue and will result in improved predictive capabilities.

PRIORITY COORDINATION ISSUES

- **Promote consistency between the agencies on data management issues:** Through the DNR's groundwater data system and the Directory of Groundwater Databases, state and local government agencies now have more convenient access to groundwater data. This effort must be maintained by continuing to identify what data needs exist and ways to make data easily accessible. Data consistency must be promoted by use of translatable geolocational coordinate systems and consistent data elements for use in a GIS environment. The GCC will continue to provide leadership and communication on data management through its subcommittees. This continued effort displays the GCC's commitment to management of the resource through sound scientific methods.
- **Coordinate and facilitate the publication and distribution of information and educational materials on groundwater related issues:** The public has benefited from the consistent educational messages that have been endorsed by the Education Subcommittee. The Education Subcommittee will continue to provide its leadership and assistance to state agencies providing educational materials to the public. Priorities for the future include promoting water stewardship, awareness of water quantity issues, and providing materials for local communities to assist in their comprehensive planning activities.
- **Distribute findings from groundwater research or monitoring projects:** More than 100 summaries of groundwater-related monitoring and research projects funded through the joint solicitation process are now available online. The rate of response to the web site posting of research findings has been very encouraging so far. To maintain and enhance this response it will be important to add new summaries annually as they become available, create a more visually appealing set of front-end pages for the site, and publicize the web site location and content more widely. More work needs to be done to target interested audiences and distribute summaries and final reports more widely.

- **Increase citizen involvement in groundwater protection:** Citizens are concerned about the protection of Wisconsin's groundwater, as evidenced by their participation in discussions of the Perrier bottling plant proposals, the routing of a possible Highway 10 bypass of Stevens Point near the municipal well field, and other local groundwater issues. However, citizen groups need a source of accurate unbiased technical information as well as assistance in organizing and communicating about their groundwater activities. Programs such as the National Groundwater Guardian program help citizen groups network and receive recognition for their efforts. Wisconsin's hiring of a statewide Groundwater Guardian coordinator (the first in the nation) is a positive step toward an active and informed citizen network and should be continued.

APPENDIX

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – AUGUST 17, 2001
DNR Central Office, Madison

Members Present: Susan Sylvester (DNR), Jamie Robertson (WGNHS), Bruce Rheineck for Nick Neher (DATCP), Henry Anderson (DHFS), and Eric Scott (Commerce)

Others Present: Tim Asplund, Jeff Helmuth, and Becky Pottratz (DNR), Ron Hennings (WGNHS), John Norman (UW-Madison), and Joe Janczy (EPA)

The meeting began at 10:00 AM.

1. **General Business** – Introductions were made. The minutes from the May 17th meeting were approved without modification. Susan Sylvester polled the GCC members present about continuing the 12 noon meeting times. Members indicated that this time period continued to work for them, but that it may be appropriate to begin the summer (August) meeting earlier in the day.
2. **Budget Update** – Susan Sylvester provided an update on the FY 02-03 budget process, and touched on several items with potential effects on the DNR and water programs. Overall, waters programs fared well in the budget passed by the legislature, with increased funding for rivers, dam safety, wetlands, and exotic species. Susan will be serving on the governor's exotic species task force, with a report due in January. [The provision to create a separate Department of Forestry was vetoed by the Governor. A requirement for an Environmental Impact Statement to be prepared for water bottlers seeking a high capacity well permit and a requirement for airborne particulate filters to be installed on new wells were also vetoed.] Commerce, DHFS, WGNHS, and DATCP did not report any major budget items pertaining to groundwater programs.
3. **Education Subcommittee Report** – Ron Hennings reported on the following activities of the Education Subcommittee, which met on July 16th:
 - Drinking Water Awareness Week (May 6-12, 2001) - Subcommittee members reviewed activities surrounding this observance. Chris Mechenich and Don Swailes (DNR) participated in a call-in show on public radio on July 3rd as a follow-up to their appearance in May. Several press releases went out from DNR and UW Extension, but it was not known how widely they were printed in newspapers. Subcommittee members plan to follow up to see if clipping services are available to track these press releases in the future.
 - Farm Progress Days – There will be a strong groundwater presence at this year's Farm Progress Days, to be held in Rock County, Sept. 18-20. All of the state agencies with groundwater and drinking water exhibits will be housed in the same pavilion, and are working together on a display involving milk jugs filled with water to represent daily water consumption. Several subcommittee members are actively involved in this endeavor.
 - Groundwater Study Guide – Subcommittee members reviewed a revised cover letter to accompany this 1991 DNR-produced guide. Efforts are being made to distribute the remaining study guides before they become too outdated.
 - Groundwater Guardian Coordinator – The Central Wisconsin Groundwater Center recently hired a half-time coordinator to work with Groundwater Guardian communities in Wisconsin and to further build a citizen constituency around groundwater and drinking water issues. This position is funded by a DNR grant using Wellhead Protection Program funds.
4. **Monitoring and Data Management Subcommittee (MDMS) Report** – Jeff Helmuth reported on the following activities of the MDMS, which met on July 17th:
 - Minimum data elements -The Subcommittee has been working on a list of minimum data elements to

assist local groundwater data managers in creating and maintaining groundwater databases. The final list was to have been reviewed and endorsed by the GCC then made available to other agencies and local governments. However, the Federal government (EPA and USGS) recently released their own set of data elements for all water quality data, which includes over 70 elements. The MDMS is reviewing this Federal list to check for similarities and differences, and will wait for a final version expected in October before proceeding further.

- Act 88 - The DNR has determined that the Privacy Act does NOT apply to groundwater databases and information.
- Well Construction Report Scanning Project - The WGNHS recently completed a substantial effort to scan in the 350,000 well construction reports dated prior to 1988 and to key in 7 data elements to allow queries of the reports electronically. This phase of the project was funded with SWAP dollars. The reports are now available on the DNR's Intranet and from WGNHS on CD. Jeff noted that this was a big effort, but that it will be very useful for a variety of purposes. Jeff thanked the WGNHS and staff members (Bill Bristoll and Irene Lippelt) for their efforts.
- DNR Well Forms Program - Over 300 drinking water well construction reports from well drillers have been uploaded since its inception earlier this year, easing workload for DNR staff. Monitoring well construction reports have been coming in slowly, partly due to limited initial promotion of the software, program staff not requesting electronic data submittals and the form's less frequent use.

5. **Planning and Mapping Subcommittee Report** - Tim Asplund reported on the following activities of the P&M Subcommittee, which last met on June 11th:

- Karst Inventory Project – Further progress on this effort has been postponed until after the Groundwater Summit. The Subcommittee will work with the Karst Data Workgroup to develop a plan for further distributing the form, developing a database, and guiding future mapping efforts.
- Smart Growth and Groundwater Issues - Subcommittee members are reviewing a draft document by UW-Extension providing guidance to local communities preparing comprehensive plans as part of the recent Smart Growth legislation. The guidance document details items to consider in developing the Natural Resources Element of the plan. Comments are due by the end of August. Chuck Warzecha (of P&M), Chris Mechenich (Education) and Dave Lindorff (Local Government) met recently to discuss developing facts sheets on incorporating groundwater issues into Smart Growth planning. They will bring their ideas to their respective subcommittees in October and report back to the GCC in November.
- NRCS – Jon Hempel, State Soil Scientist, met with the Subcommittee on June 11th and provided an update on NRCS soil mapping and digitizing initiatives. The Subcommittee also discussed having NRCS officially represented on the Subcommittee. Tim will be following up with NRCS staff and inviting them to participate in future meetings.

6. **2001 Report to the Legislature** - Tim Asplund asked for comments on the 2nd draft of the report, including specific comments on the cover letter and the section on Future Directions. Several GCC members expressed approval of the letter, which focused on the upcoming Groundwater Summit rather than listing highlights from the last year. Henry Anderson suggested referring to the Executive Summary for a listing of highlights. No additional suggestions were made for the Future Directions section, but it was generally felt that items should not be deleted from the list at this time. Henry suggested that the Future Directions section be moved to the front of the document, immediately after the Executive Summary. Others suggested making these pages a different color and handing them out at the Groundwater Summit. Tim noted that the Report would include the program for the Groundwater Summit, and would be available in mid-September.

7. **FY 03 Joint Solicitation** – Tim Asplund reported that he had recently met with Jim Hurley of the Water Resources Institute (WRI) to plan for the FY 03 Joint Solicitation. He handed out a draft timeline and

noted that dates were roughly the same as last year. The Solicitation is scheduled to go out at the end of September with a proposal deadline of November 19th. A Proposal Writer's Workshop will be held on October 24th in conjunction with the Midwest Groundwater Conference at the Inn on the Park in Madison. A major change this year will be online submission of proposals through the WRI web site. Investigators will be asked to register online at WRI and submit their proposals in Adobe Acrobat format directly to a database. This process will further streamline the review process and enable more uniform tracking and comparison of project proposals. Henry Anderson noted that many other granting agencies are using electronic submission programs and that investigators should be getting used to this process.

8. **Meet the GCC brochure** - Tim Asplund reported that the revised brochure was at the printer and should be available by the end of August. The GCC web site was also updated with photographs and biographical information for each of the GCC members.
9. **Wisconsin Groundwater Summit**– Tim Asplund provided an update on the Groundwater Summit, which will be held at the Country Inn Hotel in Waukesha on October 30-31, 2001. Tim reviewed an updated agenda for the Summit and shared lists of confirmed participating groups and groups that had not responded. Susan Sylvester asked everyone to scan through the list to identify groups that should be contacted with follow-up calls from Tim or herself. Bruce Rheineck will take the list back to Nick Neher and ask him to follow up with some of the agricultural and farming groups. Tim reported that the next step was to finalize the program and get it distributed to the Summit participants, the legislature, and key media representatives. Tim is working with Becky Pottratz, Communication and Education Specialist for the DNR's Bureau of Drinking Water and Groundwater, on a media strategy for the Summit, which will include a couple of press releases in advance of the Summit. Susan asked that the GCC members make themselves available for a conference call if needed prior to the Summit.
10. **Source Water Assessment Program (SWAP) Update** – Jeff Helmuth, DNR's SWAP team leader, commented on the following three components of SWAP activities:
 - Source Water Area Delineations – Regional modeling projects to determine source water areas for municipal systems continue in several counties, including Rock, Eau Claire, Sauk, Pierce and St. Croix, Fond du Lac, and La Crosse as well as in SEWRPC counties and the Central Sands Area. These projects should be completed in 2001 or 2002. Hydrogeologic mapping is being evaluated for use in karst areas, and may be useful for smaller public systems. Very few municipal systems seem to have impacts from the surface. In addition to being used for the SWAP and vulnerability assessments, the delineations will prove to be a useful educational tool, as the influence of hydrogeological settings on the shape of source water areas is being shown.
 - Potential Contaminant Source Data Collection – Staff have been working with several DNR programs to digitally locate high priority LUST and ERP sites, most RCRA, Superfund, and large quantity hazardous waste generators, landfills, CAFO's, and WPDES outfalls and treatment lagoons. This has been a large effort, requiring onsite visits and on-screen digitizing, but will provide useful information for many purposes beyond source water assessment.
 - Susceptibility Determinations - The completed well construction report scanning project was primarily funded to provide information for susceptibility determinations of public water systems. Groundwater age-dating is another tool that is being pursued, especially in cases where a well construction report cannot be located or other indicators of contamination are detected. Finally, a computer application to assist DNR staff in making source water and vulnerability assessments is being built into the Drinking Water System.

The deadline for completion of SWAP is May 2003. Wisconsin has the 2nd highest number of public water systems relying on groundwater in the U.S.

11. **Monitoring and Modeling of Nonpoint Pollution in Agricultural Fields** – Dr. John Norman, of UW-Madison's Soil Science Department, provided an overview of research that he has been carrying on for

the last several years with support from the UW System and DATCP through the GCC's Joint Solicitation. His research involves developing water budgets and quantifying leached chemicals from a series of experimental plots outfitted with Equilibrium Tension Lysimeters (ETL) near Arlington, WI. Plots include unfertilized and fertilized cornfields receiving no till or conventional tillage, and a restored prairie as a control. The ETL are located 4 feet below the root zone and are designed to accurately measure the amount of drainage (infiltration) from the overlying plot. Major findings from the past 5 years of continuous monitoring include:

- Drainage is the largest component of the water budget in the first 6 months of the year, while evapotranspiration is greatest in the summer and fall.
- About 10-50% of the applied N fertilizer in fall leaches to groundwater during the January – June time period.
- Drainage decreases by tillage type (Chisel plow > No till > prairie).
- N leaching is similar for chisel plow and no till.

Using this data, Dr. Norman and students have been building models to apply these results to other systems. Their approach is to link horizontal landscape models (runoff) with discrete vertical models (drainage) to be able to model where and how water flows on a whole-field scale. Inputs to the model include soil properties, topography, and weather variables, while outputs include soil moisture, drainage, yield, and grain moisture. These models have shown that even very small changes in elevation (as little as 1% slope) can have significant effects on drainage patterns and potential for leaching of chemicals. Infiltration sites can be very small, yet contribute a large proportion of the leaching from an entire field. The key to managing these fields is to keep water in place through contour plowing and strip cropping, resulting in greater overall yields, less runoff and less leaching of N and other chemicals to groundwater. Future work includes adding manure at optimal, less than optimal, and overapplied rates on a set of previously unfertilized fields to measure leaching of N from these systems and compare to fields receiving inorganic fertilizer.

The meeting adjourned at 12:30 PM. The next meeting is scheduled for 12 noon on November 9th at DATCP, 2811 Agriculture Drive, in Madison.

Respectfully submitted,

Tim Asplund, Water Resources Specialist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – NOVEMBER 9, 2001
DATCP Boardroom

Members Present: Susan Sylvester (DNR), Nick Neher (DATCP), Carol Cutshall (DOT), Fran Garb (UW-System), Henry Anderson (DHFS), and Cathy Cliff (Commerce)

Others Present: Jill Jonas and Mike Lemcke (DNR), Barb Lensch (NRCS), James Vanden Brook and Jane Larson (DATCP), Eric Scott (Commerce), Anders Andren and Jim Hurley (UW Water Resources Institute).

The meeting began at 12:00 PM.

1. **General Business** – Introductions were made. The minutes from the August 17th meeting were approved without modification. Agenda repair was made to move the update on Water System Security Issues to the beginning of the meeting.
2. **Water System Security Issues** – Jill Jonas, Director of DNR's Bureau of Drinking Water and Groundwater, provided an update on activities for protection of our water supplies that have been implemented due to the bombing of September 11th. Lines of communication have been improved between the federal government and the state. They have also been improved between the state and local water purveyors. Many contacts are being received from the local water purveyors that are trying to ascertain cost beneficial improvements to their security systems. Weekly conference calls on security are occurring to improve consistency across the state. Many training programs have been scheduled by entities involved with protection of the resource.
3. **Education Subcommittee Report** – Jane Larson reported on the following activities of the Education Subcommittee, as reported at their October meeting:
 - Farm Progress Days (Sept. 18-20 in Rock County) - Testing of water samples was offered to farmers who attended the event. Over 100 samples came in from participants from 9 different counties. 22% of those samples had nitrate with 28 mg/L being the highest value. The average concentration of the samples that had nitrate was 6 mg/L. A visualization of how much water a person uses per day was made with milk jugs and it appeared that it had some impact on attendees. Jim Gibson from the Wisconsin Technical College System offered himself as a person that farmers could follow up with for questions after Farm Progress Days were over.
 - Smart Growth – Four fact sheets are being worked on which will help communities to incorporate groundwater into their smart growth planning process. Chuck Warzecha, David Lindorff, and Christine Mechenich are taking the lead on putting them together. These initial Fact Sheets will cover a basic overview, the required 9 elements, resources on groundwater and land use, and residential development.
 - Karst Brochure – Subcommittee members are reviewing a karst tri-fold brochure that was developed by Suzanne Wade, the Rock River Coalition & UW-Extension to determine if it should be evolved to apply to other specific areas or for statewide use.
 - Brochure Review – Becky Pottratz has taken the lead on updating both the "Pesticides in Groundwater" and "Radium in Groundwater" brochures. These brochures are overdue for revision.
 - Next Meeting – The Subcommittee's next meeting is scheduled for January 24th, 2002.
4. **FY 03 Joint Solicitation** – Jim Hurley gave a demonstration of the Water Resources Institute's (WRI) Online Proposal Submission process, unveiled for the first time for this year's Solicitation. The site is designed to be very user friendly and as of the meeting already had principal investigators beginning to submit their projects. The system offers the ability for a principal investigator to submit information a piece at a time rather than only when the entire project is complete. Several former investigators used the

site in a beta test mode and had a positive reaction.

Jim also reported that the WRI is actively working on being able to leverage their monitoring and research dollars. They have received pre-approval for 104(b) base funding for the WRI and it appears that they may receive a 75 to 80 thousand dollar increase. However, the tuition remission issue will likely use up all of the increase. The WRI will try to use second year projects to effectively access the funding. Fran Garb made a motion to accept the 3 to 4 proposals that would allow WRI to access the funding. Nick Neher seconded the motion. The motion passed.

5. **Groundwater Summit Report and Steps Ahead** - Mike Lemcke reported that the Groundwater Summit was definitely a success, handed out a summary, and highlighted the work/follow-up that is yet to be done.

- Meeting Highlights – 135 delegates representing more than 50 agencies, organization, and local governments attended the Summit. The morning focused on the bringing the group up to date on the resource, its political history, and diverse viewpoints on what should be done or not done with it. The afternoon's focus was targeted at information that could be gathered through break out sessions. Quantity issues dominated the discussion in both the morning and afternoon sessions. When asked, "Is there a need for a statewide groundwater quantity strategy in Wisconsin?" 84 of 96 participants (87.5%) responded "Yes". On the evaluation forms 54 out of 54 respondents said, "we are not doing enough" to protect groundwater quantity in the state. Overall feedback on the Summit was positive. On the evaluation forms that were returned, 47 out of 53 thought the Summit was an effective means of gathering input on groundwater issues and 48 of 53 felt they had adequate input into the process.
- Key themes to emerge from the Summit – A group of GCC Subcommittee members met October 31st, 2001, to "debrief" and discuss general impressions from the Summit. Themes that were winnowed out were developing a groundwater strategy; exploring options for regionalization of water management; land use and groundwater protection; second generation of groundwater law implementation; building a groundwater constituency; whose water is it?; long term monitoring needs; surface water connections; and recognizing ecosystem services as well as economic benefits of groundwater. Further synthesis of these themes is necessary before finalizing a Summit action plan.
- What are our Next Steps? There are four items that are on the near horizon. A matrix of information that was gathered during the break out sessions will be put together and then sent out to the participants for their comments. Secondly a preliminary "Action Plan" or set of strategic actions will be established. In addition, a full conference proceedings will be developed. Lastly the Summit will feed into the Wisconsin Academy of Sciences, Arts and Letters' "Waters of Wisconsin" project.

The GCC asked that the above information be developed and that an update be brought back to them on a regular basis. The Council will then be able to determine additional subcommittee activities.

6. **2000 Survey of Agricultural Chemicals in Wisconsin Groundwater** – Jim Vanden Brook reported that the purpose of the survey was to obtain a current picture of agricultural chemicals in groundwater and to compare those levels to those surveyed in 1994 and 1996.

336 private wells in the various agricultural districts were randomly selected for this survey. 19 compounds were detected including 18 pesticides or their breakdown products. Primarily corn herbicides were found. Very few pesticides were detected in the northern third of the state. 37.7% of the wells had detectable levels of pesticides. The percentage of pesticide detected has greatly increased since 1994. However, Jim noted that the analytical ability to detect pesticides has greatly increased in the last 7 years. Alachlor and its metabolites were detected in over 25% of the wells. Acetochlor and its metabolites were also detected in the well water. Finally, atrazine is being evaluated to determine if it could be

reintroduced into an area where it had once been banned. In areas where it is being reintroduced it is being detected in well water. Survey results will be published soon.

7. **Set meeting dates for 2002** – The next four meeting dates were established. They are:

February 22nd - Water Resources Institute
May 10th - DNR Service Center, Dodgeville
August 16th - DNR, Central Office
November 15th - DHFS

8. **The meeting was adjourned.**

Respectfully submitted,

Michael Lemcke, Natural Resources Manager
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – FEBRUARY 22, 2002
Water Resources Institute Conference Room

Members Present: Susan Sylvester (DNR), Nick Neher (DATCP), Jamie Robertson (WGNHS), Carol Cutshall (DOT), Fran Garb (UW-System), Cathy Cliff (Commerce), and Jack Metcalf (Governor's representative)

Others Present: Anders Andren and Jim Hurley (UW Water Resources Institute); Ed Morse (WRWA); Shaili Pfeiffer (Wisconsin Academy); Jon Standridge (WSLH); Chris Mechenich (CWGC, via phone)

The meeting began at 12:10 PM.

1. **General Business** – Introductions were made. The minutes from the November 9th meeting were approved without modification. Susan Sylvester made note of a call she had received from a professor at UW-Superior who is interested in getting involved in regional or statewide groundwater monitoring and research activities, especially involving GIS. Susan noted that he is very interested in working with the GCC on groundwater issues in the northern part of the state. **Contact information:** Dr. William Bajjali, 715-394-8056; wbajjali@staff.uwsuper.edu; <http://frontpage.uwsuper.edu/bajjali>.
2. **Education Subcommittee Report** – Chris Mechenich made note of her pride in the work of the Subcommittee, especially in these times of budget cutbacks. She noted that the collective efforts of the Subcommittee far exceeded what could be accomplished individually. She then reported on the following activities of the Education Subcommittee, which met most recently on January 24th:
 - Groundwater Summit - The Subcommittee has been given the "Education and Communication Needs" that were identified at the Groundwater Summit, and will be ranking and prioritizing them at the next meeting. Many of the needs matched well with recent and ongoing activities of the Subcommittee, especially those related to groundwater quantity.
 - Smart Growth – As reported at the last GCC meeting, Chris, Chuck Warzecha, and David Lindorff are working on four fact sheets to help local communities incorporate groundwater into their "Smart Growth" planning process. Chris noted that these should be ready by April 1st, primarily in electronic format, and could be linked to the GCC web page, the DNR's Land Use site, and sites at UW Extension. Chris also noted that the Smart Growth process was just getting underway on the local level, and that the GCC was ahead of the curve in terms of putting this information together. Jamie Robertson asked who would be the audience for these fact sheets and expressed his view that it should be directed toward resource professionals, rather than the general public. Cathy Cliff noted that it might be worth taking a more comprehensive approach rather than focusing only on groundwater. Chris reiterated that these fact sheets were designed specifically to deal with groundwater, as it is a resource that is often overlooked when dealing with land use planning. She also noted that it was meant to be part of the technical resource kit that will be made available to the committees at the local level that will be charged with developing the specific plans. Jim Hurley noted that he was on one of those local committees and that he would find something like this to be a welcome resource. He noted that communities receiving some of the first rounds of grant assistance would be good places to distribute information, as these communities will set the stage for later efforts. *Nick Neher offered to bring up the fact sheets at the next Wisconsin Land Council meeting, and to determine how the Council plans to address educational aspects of Smart Growth.*
 - GRN/WCR access on DNR internet site – The issue of access to locational information included in the Groundwater Retrieval Network and the Well Construction database has been raised in several Subcommittees. Chris emphasized the educational value of this information to the general public and teachers, and noted that it is not very useful without the locational information that was removed as a security precaution. Cathy Cliff and Nick Neher both commented that it has presented difficulty for

their staff, though they understood that the information was available in other formats. Chris pointed out that it was primarily the private well information that was at issue, while the security concerns largely involved public water systems. *Susan Sylvester directed Tim Asplund to investigate with DNR staff the possibility of separating out the private well data from public water system data in these databases.*

- Next Meeting – The Subcommittee's next meeting is scheduled for April 2nd, 2002.

Nick Neher asked about an item in the January 24th minutes regarding the letters that well owners receive from DATCP when a substance is detected in well water samples collected in their surveys. He wondered whether the lack of response is due to people feeling adequately informed or not caring. Nick said that he would welcome any suggestions to improve the effectiveness of these letters if needed.

3. **Planning and Mapping Subcommittee Report** - Tim Asplund reported on the following activities of the Subcommittee, which last met on December 5th, 2001 (as provided by Bob Pearson):

- The Subcommittee selected a new chairperson (Bob Pearson, DOT), to replace Lisa Morrison who is stepping down after 7 years as chair;
- Bob and Ron Hennings helped UW-Extension with a new karst brochure (e.g., map, photos, review text, etc.);
- Bob submitted an abstract on behalf of the Subcommittee regarding voluntary karst mapping for the AWRA/WGWA Conference (March 7-8);
- Bob will be meeting with Mindy James of WGNHS to update and add material to the karst web site and with Lisa Morrison and Bill Bristol to determine use, applications, or modifications to the karst inventory electronic form;
- DOT (Pearson) is working with DNR (Helmuth) Source Water Assessment Program to provide GPS coordinates for statewide salt storage sheds. This information will be a new data layer for DOT and DNR Mapping.
- During spring 2002, the Subcommittee will send out "canned" reminders to all state agency staff (field folks in particular) to consider filling out the karst form if features are observed or noted during routine activities.

Tim mentioned that the Subcommittee would be involved in evaluating output from the Groundwater Summit and that it was looking to undertake new initiatives. One example of a possible project is to produce a Wisconsin GIS Environmental Mapping Index pamphlet (e.g., like Indiana's or Florida's). It could be a simple index highlighting the various themes, layers, dates, scales, and contacts for all state agencies, and would be a useful reference tool for all to use (state, local, private, planning commissions, etc.). Bob Pearson noted that currently all the "environmental data layers" are scattered throughout the various state agencies, and determining who has what layer is problematic for general workers and the public. *Nick Neher agreed with this need, and said he would bring up this issue to the Land Council.*

4. **Monitoring & Data Management Subcommittee Report** - Tim Asplund summarized highlights from the November 27th, 2001, meeting, as provided by Jeff Helmuth:

- FY 03 Joint Solicitation - The Subcommittee was actively involved in reviewing proposals and met with the Research Subcommittee on January 9th.
- Groundwater Summit - The Subcommittee reviewed a draft list of Research and Monitoring/Data Management needs that were identified in some of the various breakout sessions. *A "final" list will be reviewed at the next meeting.*
- Minimum Data Elements - This effort has been delayed due to a Federal data standards document recently produced by an EPA/USGS group. The group approved a second draft of the document in November, but it will likely be updated and revised periodically. The Subcommittee decided to go back to the original Minimum Data Elements document and rework it to provide references to the full EPA/USGS report rather than try to incorporate the Federal standards. The intention of the guidance is to give Wisconsin groundwater data managers a starting point and to help with data sharing

between agencies and with local partners. Database managers would be encouraged to use these other sources as references. A “final” draft was sent out for comments (comments due 2/22/02). *Tim asked if the GCC wanted to provide comments and/or approval via email or if this should be an agenda item for the May meeting? Members indicated that email would be fine, and Tim said that he would provide a hard copy of the document at the next meeting.*

- **Karst Reporting Form computer application** - Randell Clark developed an application to allow users to create their own karst database on their computer and share files with other users and ultimately with the WGNHS. This is one piece of a larger effort to create a statewide database of karst features and would be beneficial to people with existing databases. The Karst Data Workgroup needs to do some more work in terms of defining karst and put some limits on what should be in the database. For now, the WGNHS will accept email submissions of databases created with this program and keep them on file, but would not be able to create and maintain a master database at this time.

5. **FY 03 Joint Solicitation and UWS Groundwater Research Plan** – Jim Hurley provided an overview of this year's solicitation process, which was enhanced by the electronic submission and review process developed by WRI. Jim noted that this system allowed for a fairly rapid turnaround time between the proposal deadline (Nov. 15th) and the Groundwater Research Advisory Council (GRAC) meeting (Feb 15th). A few statistics on the process:

- 38 proposals were submitted, of which 33 were eligible for UWS funding;
- over \$1 million was requested for FY 03; proposals averaged \$33,000 in the first year;
- 11 new researchers submitted proposals;
- 10 institutions were represented, including UW Whitewater for the first time;
- 250 email requests for reviews were sent out: 155 (62%) accepted, 145 (94%) completed;
- All except 1 proposal had at least 3 separate reviews.

Jim noted that the GRAC meeting was particularly intense this year, as DNR, DATCP, and Commerce were unable to commit significant funds to new projects for FY 03. Jim then handed out a summary of the UWS plan for FY 03, as recommended by GRAC. He noted that 2 of the 7 continuing projects would be covered by USGS matching funds, as approved by the GCC in November. He also noted that there had been some slight modifications to project budgets since the GRAC meeting, which resulted in being able to fully fund 5 projects, and put some money back into one project that had been cut back. One project will also receive some funds from the DNR to cover part of the drilling costs. Finally, Jim noted that only 2 of the projects would carry over into FY 04, meaning that the full \$270,000 might be available for new projects next year if USGS match is still available. *Nick Neher expressed his appreciation at the level of organization and effort that the WRI provided this year and made a motion to approve the UWS Groundwater Research Plan as presented. Jack Metcalf seconded the motion and the motion carried unanimously.*

6. **Future Funding for Monitoring and Research**- Jamie Robertson made note that it has been very helpful and appropriate in the past for DNR to be a player in the Joint Solicitation process, and that he recognized that this year was unusual. However, he expressed his concern that this not turn into a long term reality and that he felt the GCC should go on record to support DNR's involvement in the past and the future. Nick Neher echoed this sentiment and broadened it to DATCP and all of the other agencies represented on the GCC. *Susan Sylvester reiterated her support for agency participation in the process and directed Tim Asplund to draft a letter to go to all of the agency secretaries in support of future monitoring and research funding, while acknowledging the current budget situation.*
7. **Wisconsin Fertilizer Research Council (WFRC)** - Tim Asplund reported that he had met recently with Jim Jacobus, Manager of the WFRC research program, and Jeff Postle and Kevin Beckard of DATCP to discuss ways to better share information and proposals of mutual interest. Tim noted that occasionally proposals are submitted to the Joint Solicitation that might better fit the WFRC process and vice versa,

and that the decision-making time frame was very similar. However, there are significant differences in the scope, funding level, and review process for the two solicitations. No formal plan was developed at this time, but Tim and Jim agreed to share relevant proposals in the future and ensure communication throughout the review and decision-making process.

8. **National Water Quality Monitoring Council (NWQMC) Conference** -Tim Asplund noted that he had submitted an abstract and would be presenting a paper at the upcoming NWQMC conference at the Monona Terrace Convention Center on May 20-23, 2002. The title of the paper is " The Joint Solicitation – Wisconsin's Groundwater Research and Monitoring Partnership." The paper will be part of a workshop on capacity building for State Monitoring Councils, and will focus on the successes of the GCC and the Joint Solicitation. (See <http://nwqmc.site.net>).
9. **Groundwater Summit Update and Directions** - Tim Asplund handed out a list of accomplishments to date and tasks ahead as a follow-up to the Groundwater Summit held October 30, 2001. Some of the key accomplishments included:
 - A press release that went out on November 26th summarizing the Summit highlights;
 - Transcriptions of all the morning presentations, 75% of which have been edited by the speaker;
 - A compilation of the small group Breakout Session comments into a matrix of needs and potential solutions;
 - Updates to the GCC Summit web page, including highlights, a list of proposed outcomes, speaker biographies, a participant list, PowerPoint presentations and the Breakout Session Matrix (<http://www.dnr.state.wi.us/org/water/dwg/gcc/GCC-GWSUMMIT.HTM>);
 - Notification to Summit participants about the updated web page and an invitation to comment on the Breakout Session Matrix (by March 15th);
 - Lists of the Breakout Session comments provided to the Monitoring and Data Management and Education Subcommittees.

Tim noted that he would be gathering some of the GCC Subcommittee members that attended the Summit to help formulate the "Strategic Agenda" this spring, and hoped to report back to the GCC at the May meeting. All of the Subcommittee Chairs and most of the agencies are represented in this "Core Group." *Cathy Cliff agreed to find someone from Commerce who would be willing to participate.* The GCC again reiterated their concern about the policy implications of some of the recommendations from the Summit. Tim noted that he would direct the "Core Group" to be careful about the language used in the Strategic Agenda, and that it would be clearly stated that any policy recommendations were garnered from the Summit participants, and do not necessarily represent the views of the GCC. Additional tasks ahead include further refining the Breakout Session Matrix and putting together the Summit Proceedings to serve as a complete record of the Summit and its outcomes. Finally, Tim will continue to work with "Waters of Wisconsin" (WOW) to incorporate groundwater issues and Summit follow-up discussion into their Fall Forum and other activities (see below).

10. **Waters of Wisconsin Initiative** - Shaili Pfeiffer, Project Coordinator with the Wisconsin Academy of Sciences, Arts, and Letters, provided an overview of the Waters of Wisconsin Initiative, which has been underway for about a year and will culminate in a Fall Forum on October 21-22, 2002 at the Monona Terrace. The initiative is a "first-of-its-kind" attempt by the Academy to provide a neutral framework for addressing long-term policy issues that are facing the State. A 20-person committee and a larger Advisory Network of water resource professionals from a variety of disciplines guide the effort. Some of the key components of the initiative include regional public forums focusing on different water issues, assessing the current Status and trends of water and aquatic resources, drafting a set of Sustainability principles, and developing alternative Scenarios for the future. These efforts will culminate in a report on the future of Wisconsin's water resources and the Fall Forum, where the report will be presented and further developed. The organizers hope that the initiative will set into motion policy discussions on a variety of levels and set

into place a comprehensive water policy for the State. More information can be found on the Wisconsin Academy's web site (<http://www.wisconsinacademy.org>) or by contacting Shaili (smpfeiffer@facstaff.wisc.edu).

11. **Technical Presentation** - Jon Standridge, of the Wisconsin State Laboratory of Hygiene, gave a presentation on a recently completed study titled "Passage of Microorganisms In Septic System Effluents Through Mound Sand In a Controlled Laboratory Environment." This study was funded by the WDNR, and driven by recent rules (Comm 83) regulating private onsite wastewater treatment systems (POWTS), as well as public health and resource protection concerns related to microbial pathogens. The specific focus of the study was to evaluate the removal of microbes from POWTS wastewater by sand that is typically used in mound systems. Jon noted that there are many factors that affect removal (filtration, adsorption and die-off), but that the main factors assessed in this study were loading rate (1-8 gal/ft²/day), effluent quality (10³ - 10⁷ fecal coliforms), column length (12 - 60 inches), and dosing frequency (1 or 5 times per day). In addition, the study employed a range of microbial indicators, including total coliform, fecal coliform, *E. coli*, enterococci, and coliphage. The basic procedure was to introduce wastewater effluent at regular intervals to a set of columns packed with sand for a period of several months. Every 3 weeks, the effluent was collected from the bottom of the columns and tested for the presence of the microbial indicators. Each column had a unique combination of effluent quality and length. The loading rate was applied evenly for all columns, but doubled twice during the course of the experiment.

The results of the study were fairly complex, but significant findings included:

- **Low total coliform, fecal coliform or *E. coli*** loads present in **high** quality effluents do not pass through 12 inches of mound sand when dosed evenly throughout the day at 2 gallons per square foot per day.
 - As dose volume is doubled (4 and 8 gallons per square foot per day), **total coliform** breakthrough occurs, but not **fecal coliform or *E. coli***.
 - If dose volume is not spaced throughout the day, **total coliform, fecal coliform and *E. coli*** breakthrough occurs.
- **High total coliform, fecal coliform, and *E. coli*** loads present in **low** quality effluents do not pass through 24 inches of mound sand when dosed evenly throughout the day at 2 gallons per square foot per day.
 - Doubling dosage rate to 4 gallons per day results in passage of **total coliform, fecal coliform, and *E. coli*** organisms, even through 60-inch columns.
- *E. coli* is a slightly more sensitive indicator of microbial passage through mound sand than is **fecal coliform**, while **total coliform** is a substantially better indicator of microbial passage than *E. coli*.
- **Enterococci** and **coliphage** are not better indicators than the traditional coliform indicators.

Some discussion of the implications of the study ensued, along with some suggestions for presenting and interpreting the results for future publications. Jon noted that he hoped to team up with engineers and soil scientists, possibly from WDNR, to put together a paper for peer-reviewed publication. Copies of the report can be obtained from Jon directly (jhs@mail.slh.wisc.edu) or from Tim Asplund.

12. **Commerce Report Due to GCC** - Susan Sylvester noted that there is a provision in Comm 83.71(7), Wis. Adm. Code, for an annual report on POWTS performance monitoring activities of the Department of Commerce that is to be provided to the GCC on an annual basis. The first report was due December 31, 2001, but the GCC has not received any report to date. *Cathy Cliff agreed to follow up on this item with the appropriate administrator in Commerce.*
13. **The meeting was adjourned.** The next meeting is scheduled for Friday, May 10th, 2002, at the DNR Service Center in Dodgeville.

Respectfully submitted,

Tim Asplund, Water Resources Specialist
Department of Natural Resources

**Wisconsin Groundwater Coordinating Council
DRAFT MEETING MINUTES – MAY 17, 2002
Department of Natural Resources Board Room**

Members Present: Nick Neher (DATCP), Carol Cutshall (DOT), Fran Garb (UW-System), Cathy Cliff (Commerce), Mike Lemcke for Susan Sylvester (DNR), and Ron Hennings for Jamie Robertson (WGNHS)

Others Present: Jim Hurley (UW Water Resources Institute), Bob Pearson (DOT), Dave Lindorff and Tim Asplund (DNR), Madeline Gotkowitz (WGNHS), and Brian Barrett (SEWRPC)

The meeting began at 12:10 PM.

1. **General Business** – Introductions were made. The minutes from the February 22nd meeting were approved without modification. The agenda was modified to include a discussion item related to the Report to the Legislature.

2. **Education Subcommittee Report** – Tim Asplund reported that Jane Larson was stepping down from the Subcommittee, due to her changing responsibilities at DATCP. Jane Larson had been a member of the Education Subcommittee since October 1993. Tim read the following comments from Chris Mechenich:

Jane has been a highly valued and productive member, faithfully keeping us informed about groundwater-related activities at DATCP, and bringing in other DATCP staff to help with projects or answer questions where needed. She helped organize the GCC's first groundwater education session for legislators held in the Capitol Rotunda. She was a frequent volunteer for ad-hoc subgroups to brainstorm ideas or review materials, and was an important member of the interagency group that developed the "Tests for Drinking Water from Private Wells" brochure published by DNR. She also cheerfully accepted the role of hosting the bimonthly subcommittee meetings at DATCP for the last several years.

Nick Neher noted that budget cuts resulted in reduced staff in the public information office, requiring Jane to take on additional responsibilities for the Department. Randy Zogbaum, a hydrogeologist in the Water Quality Section, will replace Jane on the Subcommittee.

Tim noted that the Subcommittee had further discussed Nick Neher's inquiry about the adequacy of DATCP's letters to private well owners when a detectable level of a pesticide was found in their well. Jeff Postle had clarified that the letter itself referred people to Jeff or to the local DNR drinking water specialist, but that it was his standard practice to refer people to DHFS with any health related questions related to the letter or the sampling results. Nick noted that one follow-up study done by DATCP had found that 50% of people still used their well after being notified of a detectable level.

Tim passed around a copy of a press release that went out the week before Drinking Water Awareness Week that highlighted the Groundwater Summit and quoted Susan Sylvester and Jamie Robertson. Other press releases went out around the same time. Tim also noted that Becky Pottratz of the DNR was working with Wisconsin Public Radio to produce a series of radio call-in programs related to drinking water and groundwater issues.

Finally, Tim noted that several members of the Subcommittee would be staffing booths and displays at the upcoming Farm Progress Days in Richland County (July 9-11). The highlight of this effort is UW Extension's well testing program. Ron Hennings noted that this effort was a good example of the collaboration that goes on as a result of the GCC.

3. **Planning and Mapping Subcommittee Report** - Bob Pearson gave a quick summary of the Subcommittee meeting minutes from April 3rd, noting that the "Agency Updates" occurred at the beginning of the meeting to ensure that adequate time was given to this important activity. He pointed out that Jeff Helmuth gave an update on SWAP (Source Water Assessment Program) and the DNR's Land

Legacy project. He also noted that the Subcommittee continues to press ahead on the karst mapping initiative, though it did not appear on the agenda for the last meeting.

Bob then highlighted two areas that the Subcommittee will be focusing on. One possible project is to produce a GIS Index or Catalog for groundwater information. As a start, Subcommittee members will be extracting the groundwater-specific information from the agency Land Integration Plans that were submitted to DOA in April. The index or catalog could be a simple brochure or web site, highlighting the various themes, layers, dates, scales, and contacts for groundwater information available from state agencies. A second area of focus will be evaluating the role and responsibility of the Subcommittee, especially as its focus has shifted from planning to mapping related activities. There is some overlap with the Monitoring and Data Management Subcommittee, and Bob noted that the 2 Subcommittees would be meeting jointly in July to discuss these issues.

Finally, Bob reiterated his view that one of the primary benefits of the Subcommittee and the GCC as a whole was the loose confederation or "underground network" of groundwater professionals that interact as a result of their participation in GCC activities. These interactions produce many intangible benefits, and are as important as the specific products that are generated. Bob suggested to the GCC that it may wish to direct Subcommittee members to document these sorts of activities for future reports or audits that may occur. *Nick Neher suggested that this be an agenda item for the next meeting.*

4. **2002 Report to the Legislature** - Following up on Bob Pearson's comments, Nick Neher suggested that each Subcommittee be asked to contribute one or two examples of activities that illustrate the "synergistic" or intangible benefits of the Subcommittees or the GCC for the 2002 Report to the Legislature. Examples could include "personal interest stories" or activities that happen without a direct charge from the GCC. These examples will be included in the Subcommittee Activities section and highlighted in the Executive Summary. Nick noted that these examples would be useful to show the legislature and citizens how the GCC pays dividends by fostering communication and reducing redundancies and inefficiencies.

Tim Asplund then handed out a proposed outline and timeline for the 2002 Report, which is due in August. He noted that the Education Subcommittee would be discussing ways to streamline the report and better highlight significant accomplishments and activities at its next meeting. He asked if there were any comments or suggestions from the GCC. Discussion ensued on the purpose of the report and whether any changes were needed. It was agreed that the report serves a useful purpose as a general reference and compendium of groundwater-related activities, but that it probably could be made more user-friendly. *Nick noted that the GCC would be open to recommendations from Tim or the Subcommittee on streamlining the report in the future.*

5. **Monitoring & Data Management Subcommittee Report** - Mike Lemcke noted that the Subcommittee had finalized the "Recommended Minimum Elements for Groundwater Databases" and that a draft copy had been provided in the meeting packet. Distribution of the document would be occurring in the next few months. Mike also reported on the status of access to the DNR's GRN and WCR databases on the internet. Mike noted that Wisconsin has always been proactive at providing access to well information, but that recent events have precluded this open policy. Arrangements are being made with other agencies and partners (DATCP, CWGC, and WGNHS) to allow full access via a password system, though this has been a fairly rigorous process. Commerce and DOT are welcome to obtain access in this way if they are interested. Mike noted that this solution did not address the issue of public access and the educational uses that the information has been used for in the past. He noted that staff are continuing to explore the possibility of restoring locational information for private wells only. He expressed his hope that the security concerns would be eased in the next 6-12 months, and that the DNR could continue its tradition of open access.

6. **Local Government Subcommittee Report** - Dave Lindorff summarized the May 1st conference call of the Subcommittee, noting that it had last met in October 2000. Mayor Carol Lombardi of Waukesha and Mayor John David of Watertown agreed to join the Subcommittee as representatives of the Wisconsin Alliance of Cities (WAC). Lawrie Kobsa, representing the Municipal Environmental Group and Brian Barrett, former General Manager for the Waukesha Water Utility and current chair of the Groundwater Technical Advisory Committee for SEWRPC, also participated.

Dave noted that much of the discussion focused on feedback from the Groundwater Summit and the items from the breakout session matrix that were related to Local Government (regional water management, groundwater quantity, and Smart Growth). The Subcommittee also gave positive feedback on the Smart Growth Fact Sheets that Dave and others have been working on (see next item) and gave suggestions for distributing them to local partners. The group also discussed future directions for the Subcommittee, and agreed to meet more frequently, with a focus on groundwater quantity issues and regional approaches. The next meeting will be in late August or early September.

7. **Smart Growth Fact Sheets** - Dave Lindorff provided an update on the development of the Smart Growth Fact Sheets that Chris Mechenich reported on at the February GCC meeting. Dave reiterated that the Fact Sheets were the result of discussion in various Subcommittees about how best to share information on groundwater with local governments as they go through their comprehensive planning process, spurred on by the "Smart Growth" law. This process presents a golden opportunity to encourage groundwater protection activities at the local level. Dave noted that the Fact Sheets should be completed in the next couple of months, and would be made available on the GCC web site, the DNR's Land Use information page, and through UW Extension. Dave mentioned that he, Chris, and Chuck Warzecha were also discussing other ways to distribute the fact sheets, perhaps through targeted mailings to local government groups, planning organizations, or the recipients of DOA grants. *The GCC cautioned against "reinventing the wheel" and encouraged Dave to look into any existing distribution system through DOA's Office of Land Information Services (OLIS), or the Land Council before doing any widespread mailings.*
8. **Report from Commerce re: Performance Monitoring of POWTS (Onsite Systems)** - Cathy Cliff noted that she had passed along the GCC's inquiry about the report required in Comm 83 on the Department of Commerce's Performance Monitoring activities, and that a copy of the report was included in the meeting packet. She requested that any specific questions on the report be directed to Mike Corry or Roman Kaminski in the Buildings and Safety Division. Ron Hennings noted that the report indicated that very little monitoring had been done due to limited budgets, and expressed his hope that more extensive monitoring be done in the future.
9. **Letter to Agency Secretaries** - Tim Asplund noted that he had followed up on the GCC's request from the last meeting to send out a letter to all of the agency secretaries acknowledging the limited budgets for the current fiscal year and expressing the hope of the GCC for restored funding in the future for groundwater monitoring and research. A copy of the letter was included in the meeting packet. Ron Hennings noted that Jamie Robertson was very pleased with the letter. Cathy Cliff noted that Commerce Secretary Philip Albert did respond to the letter and expressed his agency's support for groundwater research and monitoring in the future as budgets allow.
10. **Groundwater Summit Update and Draft "Strategy" Document** - Tim Asplund provided an overview of progress made on putting together a summary of the Groundwater Summit held October 30, 2001. He noted that a "core group" of GCC Subcommittee members, including chairs of each Subcommittee and representatives from each agency had met in April and fleshed out a format and structure for the strategy document. The group spent considerable time discussing the purpose of the document and how it would

be used in the future. The group decided that it would be best to steer away from the term "strategy" in the title, and that it was more appropriately a summary or synthesis of ideas and directions. However, the group felt that it would be worth asking groups (agencies, local governments, nonprofit or advocacy organizations) to endorse the document and make use of it in developing their own specific strategies or planning activities. Tim then explained the timeline for completing the document, noting that it still needed one final round of review by the core group. The goal is to provide the document to Summit participants for their review in early June, and then include a final version in the 2002 Report to the Legislature.

Tim then walked the GCC through the document and asked for any feedback or specific comments. Brian Barrett noted that the issue of aquifer depletion and water table declines could be made more explicit in the introduction. Cathy Cliff asked for further clarification on the concept of "endorsement", saying that it should be clear that endorsing the document means that an entity agrees that the concepts should be explored, not that every specific strategy be agreed to. Fran Garb noted that the document could use some tighter editing and sprucing up with more appealing formatting, but that she felt the document accomplished its purpose and was the necessary length for capturing all of the concepts. *The GCC gave its approval to go ahead with the final editing and distribute to the Summit participants for their review.*

11. **Review of Joint Solicitation process** – Jim Hurley noted that this year's joint solicitation raised some issues with the process, related in a large part to the tighter budgets and increased competition for the limited funds. In particular, there were questions about the intended use of funds, the review process, and confidentiality of the decision-making. He noted that he, Tim Asplund, and Mike Lemcke had met earlier this spring to discuss these issues and had reviewed the existing MOU between the UW System, the Groundwater Research Advisory Council (GRAC), and the GCC. Jim noted that there were some differences between the MOU and current practice, in particular the way that scores from external reviewers and the GCC Subcommittees are presented to the GRAC. Jim suggested that updating the MOU to reflect current practice might be the best way to address some of the concerns about the review process. Mike Lemcke then gave some background on the MOU, and noted that the WRI's system had evolved well beyond the process outlined in the 1991 MOU. Fran Garb agreed saying that the MOU did not reflect the rigor of the process now and strongly urged that a new MOU be drafted. Nick Neher also agreed, and said to be sure to leave some flexibility in the MOU to allow further improvement to the process. *Fran volunteered to work with Jim to draft a new MOU that would come from the UW System and be provided to the GCC in August for their approval.*

Jim then discussed some concerns that he had regarding confidentiality of the GRAC process, in particular the discussion of specific proposals and decisions made in the GRAC meeting outside of the GRAC. Jim asked for the GCC's input on how best to handle this concern in the future. *The GCC felt that it would be best for the chairs of the GRAC and the GCC Subcommittees to reiterate the need for confidentiality at the front end of the process, both in any written communication and at the beginning of the review meetings.*

12. **Technical Presentation on Sauk County Hydrogeologic Modeling** - Ron Hennings introduced Madeline Gotkowitz, a hydrogeologist with the Wisconsin Geological and Natural History Survey (WGNHS), who presented an overview of a recently completed modeling project for Sauk County. Madeline noted that funding for the project had come from the Source Water Assessment Program administered by the DNR, and was one of several regional modeling projects being coordinated through that program for the purpose of delineating source water areas for municipal wells. Madeline also noted that there was considerable local interest in the project, and that the modeling would be a useful tool to help the County manage and preserve its water resources. A number of products were generated by the project, including a database of all wells in the county, 1:100,000 scale Depth to Bedrock and Water Table maps, a conceptual 3D hydrogeologic model, and information on zones of contribution for the

county's 14 municipal well systems. Madeline then went into detail about the interesting features of the county, the elements of the conceptual model, and some of the questions that could be answered by the model. She noted that Sauk County appeared to be in good shape in terms of its water resources and that there did not appear to be any long term declines in water tables as seen in other regions of the state.

Nick Neher asked how this area was chosen for study and whether this level of effort could be applied in other areas. Mike Lemcke noted that study locations were chosen to match available expertise and population centers, and that all municipalities larger than 9000 were currently part of a completed or ongoing SWAP project. Nick also asked whether this information could be used to assess the impact of a proposed high capacity well within the county. Madeline noted that the model was meant to provide information on a larger scale for educational purposes and decision-making about land use and well siting, but that detailed testing and modeling would still be necessary to determine localized impacts of a particular well. Cathy Cliff noted that there is a large amount of information from remediation sites buried in files and wondered if compiling this information in a centralized place would eliminate the need for new tests and wells for every new site. Madeline answered that even if all this data were compiled, the scale would be larger than the local information needed for a particular remediation site. The GCC thanked Madeline for her presentation.

13. Miscellaneous agency updates:

- Mike Lemcke noted that the DNR would be going to the Natural Resources Board in June to ask for authorization for public hearings on the next round of groundwater standards, which will include a standard for alachlor ESA.
- Mike also noted that atrazine may again be a "hot" issue in the future, with the recent publication of reports linking atrazine with frog abnormalities. He noted that the current groundwater standard and prohibition areas are based on human health standards for drinking water, not to protect frogs. He also noted that there are currently no surface water standards for atrazine. Nick Neher noted that their recent survey showed that atrazine levels are declining in private wells.
- Nick mentioned that DATCP is currently performing an agricultural impact statement for an herbicide known as Balance, and may consider a special local needs regulation. Nick also noted that DATCP would not be proposing any additional atrazine prohibition areas this year, as they are not finding any evidence for a need.

14. The meeting was adjourned. The next meeting is scheduled for Friday, August 16th, 2002, at the Department of Commerce office at 201 West Washington Avenue in Madison.

Respectfully submitted,

Tim Asplund, Water Resources Specialist
Department of Natural Resources

FY03 Joint Solicitation of Groundwater and Related Research/Monitoring Proposals

September 2001

The University of Wisconsin System (UWS) and the Wisconsin Departments of Natural Resources (DNR), Agriculture, Trade, and Consumer Protection (DATCP), and Commerce annually participate in a joint solicitation for research or monitoring proposals dealing with groundwater and/or pesticides. The four state agencies will have approximately \$700,000 available for groundwater-related monitoring or research in fiscal year 2003 (July 1, 2002 – June 30, 2003). Approximately \$330,000 of that total will be available for new projects. The four monitoring/research programs are summarized as follows:

1. UWS Groundwater Research - The UWS, through its UW-Madison Water Resources Institute (WRI), has received funding since FY 90 for groundwater research. They will have \$300,000 to fund research in FY 03. Through FY 01, the UWS has spent \$3.5 million on 97 groundwater research projects. Several projects have been co-funded with DNR, Commerce and/or DATCP and five were co-funded with WRI through the US Geological Survey.
2. DNR Management Practice Monitoring - The DNR has been funding groundwater management practice monitoring projects since FY 86. The DNR has approximately \$275,000 available for FY 03 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities that may impact groundwater are conducted. The money comes from the Groundwater Account of the Environmental Fund (which is funded by various fees). Through FY 01, the DNR has spent approximately \$5.0 million on 151 monitoring projects. Several of these projects have been co-funded with DATCP, Commerce and/or UWS.
3. DATCP Pesticide Research - Since 1989, the DATCP has had approximately \$135,000 available annually to fund research on pesticide issues of regulatory importance. This money comes from fees paid by pesticide manufacturers to sell products in Wisconsin. Through FY 01, the DATCP has spent about \$1.5 million on 39 pesticide projects. Some of these projects have been co-funded with DNR and/or UWS.
4. Department of Commerce Private Sewage System Research – The Division of Safety & Buildings (formerly in the Department of Industry, Labor, and Human Relations) received an annual appropriation of \$50,000 from 1990 to 1993 to fund research on alternatives to current private sewage-system technology. In 1994, when the appropriation expired, \$75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Commerce will not have any funds available for new research projects in FY 03. Through FY 01, the DILHR/Commerce has spent approximately \$600,000 on eight projects. Two projects were co-funded with DNR and UWS.

The Wisconsin Groundwater Coordinating Council (GCC) provides consistency and coordination among the four state agencies in funding groundwater monitoring and research to meet state agency needs. The reasons for this solicitation to be made jointly are to:

- Facilitate proposal writing
- Streamline the review process
- Curtail duplication
- Improve coordination among agencies and researchers
- Enhance communication among the agencies and among principal investigators (P.I.)

Joint funding of some projects may be appropriate, but joint funding is not the purpose of this solicitation because each agency has its own designated mission and priorities. Although all proposals received will be distributed to each agency, each investigator is asked to identify the agency whose mission and priorities best match their project.

Please read the solicitation carefully; it contains a description of the priorities for each agency program and other pertinent information, including a new online proposal submission process. Capital items may not be purchased with these funds, and faculty salaries plus fringe benefits will be limited to a maximum of 10% of an individual grant (e.g., for a \$20,000 grant, a maximum of \$2,000 can be allotted to faculty salaries and fringe benefits).

Investigators who are new to this program are encouraged to solicit an example proposal from the agency contacts listed below and attend the Proposal Writer's Workshop on October 24, 2001.

If you have questions please call the following appropriate agency contacts.

James P. Hurley, UW Water Resources Institute: (608) 262-1136; hurley@wri.wisc.edu

Tim Asplund, Department of Natural Resources: (608) 267-7449; asplut@dnr.state.wi.us

Jeff Postle, Department of Agriculture, Trade and Consumer Protection (608) 224-4503;
jeff.postle@datcp.state.wi.us

Harold Stanlick, Department of Commerce: (262) 521-5065; hstanlick@commerce.state.wi.us

Eligibility

Please note that each agency has separate requirements for eligibility. Review the agency-specific sections carefully. In general:

UWS: Funds are restricted for use by faculty within the UW System or by academic staff who have achieved nomination to P.I. status.

DNR: Funds are restricted to use by UWS and state agency contractors.

DATCP: Any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research may submit proposals.

Investigators who are not affiliated with the state and therefore not eligible for funding by UWS or DNR may wish to collaborate on a proposal with a UWS investigator or state agency staff member.

A principal investigator with unfinished Joint Solicitation-funded final reports that are significantly overdue (in the case of UWS by more than six months) with respect to initially specified or understood completion dates will not be eligible for new funding. The Groundwater Coordinating Council may consider extenuating circumstances on a case-by-case basis.

Submission of Proposals

New this year – Online proposal submission

Proposals for this year's Joint Solicitation will be submitted entirely online, through the University of Wisconsin Water Resources Institute's Web site at <http://wri.wisc.edu>. The Web site will be ready for principal investigator registration and proposal uploads after October 15, 2001. **The deadline for submittal of proposals is 6:00 PM Monday, November 19, 2001.**

Please note that investigators will be required to register on the Web site prior to submitting a proposal. This step can be accomplished at any time after October 15. Investigators should be prepared to provide the following information when submitting a proposal online:

- Title
- Investigators
- Abstract (condensed version of project summary separate from the Project Narrative that is uploaded as a .pdf file)
- Location of Research
- Names and addresses of three qualified reviewers of proposal (two must be from outside of Wisconsin; include areas of reviewer expertise)
- Target agency ranking
- Adobe Acrobat file (.pdf) of proposal narrative
- Budget information

Investigators will be required to upload a .pdf version of their proposal to the WRI Web site. In order to create a .pdf file, investigators will need to either use Adobe Acrobat software or go online to Adobe's site to create a .pdf file. Adobe offers a monthly subscription for pdf file creation or a free trial period that enables creation of 5 pdf files at: <http://www.adobe.com/store/products/createpdf.html>. Complete instructions for online submission can be found at the WRI Web site.

Proposals should be no longer than 18 pages. All pages should be 8.5" x 11". The project summary, narrative, curriculum vitae, and support pages should start on a new page, be double-spaced (except for Figure and Table legends), and use no smaller than 11-point font. All margins should be no less than 0.75 inches. The proposal narrative must be consecutively paginated on the bottom of the page. Include literature citations in the proposal where appropriate (single-spaced within, double-spaced between). Any section of a proposal that exceeds the specified maximum page limits will be grounds for returning the proposal to the author. A proposal guideline checklist is provided on page 7 to assist proposal authors.

All proposals must be submitted online. No facsimiles of proposals and no hand-written proposals will be accepted. Special attachments (maps, brochures, etc.) will be accepted, noted, and kept on file, but will not be included in the package of materials submitted to reviewers.

Review of Proposals

All proposals received through the joint solicitation process receive reviews from the following four groups:

1. External peer review: The UW Water Resources Institute solicits a minimum of four external peer reviews of all proposals. (As part of this peer review process, investigators should provide the names, addresses and email of three suggested reviewers with expertise in the field of the proposal.)
2. The Research and Monitoring & Data Management Subcommittees of the GCC
3. The Groundwater Research Advisory Council
4. Staff from the funding agencies

The most important consideration of the reviewers is whether the proposal meets agency priorities as outlined in this solicitation. Other criteria include project cost, proposed timeline, whether the proposed project methodology meets the stated objectives, whether the resources requested are adequate to carry out the project, and whether the project investigators have the abilities to complete the proposed project. Funding decisions will be made in March 2002. Proposals that are funded become the property of the granting Wisconsin state agency.

Proposals that are not chosen for funding through this solicitation may be referred to other funding sources for their consideration with permission of the investigators. Likewise, other funding organizations may refer proposals to the funding agencies involved in this solicitation.

Guidelines for Proposal Submission

(See WRI web site <http://wri.wisc.edu> for complete submission details)

I. Investigator and Proposal Information (entered online)

- A. Title
- B. Investigators (from drop-down menu of investigators previously-registered on the site)
- C. Abstract (condensed version of project summary separate from the Project Narrative that is uploaded as a .pdf file)
- D. Location of Research
- E. Names and addresses of three qualified reviewers of proposal (two must be from outside of Wisconsin; include areas of reviewer expertise)
- F. Target agency ranking

II. Proposal text (uploaded as Adobe Acrobat .pdf file to the WRI web site).

- A. Title, Investigators, Affiliations of Investigators (top of first page)
- B. Project Summary (begin on same page, **not to exceed 2 double-spaced pages**)
 - 1. Specific groundwater or related problem addressed by research/monitoring proposal.
 - 2. What will findings contribute to problem solution or understanding?
 - 3. Project objectives.
 - 4. Project approach to achieve objectives including methods and procedures.
 - 5. Users of project findings.
- C. Proposal Narrative (begin on new page, **not to exceed 10 double-spaced pages**)
 - 1. Objectives
 - 2. Background information describing prior research/monitoring relevant to objectives; references to ongoing projects and how they relate to proposed investigation; information gaps which will be filled by the proposed project.
 - 3. Project plan outlining experimental design and schedule
 - 4. Methods detailed enough to convince the reviewer that the investigators are up-to-date on modern techniques; a general statement alluding to techniques is not acceptable.
 - 5. Relevance to groundwater and related problems
 - 6. Citations

7. Training support (if any) provided by the project and information dissemination plan.

D. Curriculum vitae of Principal Investigators (begin on new page, **not to exceed 4 pages**)

Include curriculum vitae (including recent publications) of each investigator and state the time each will spend on the project.

E. Current or pending support. (begin on new page, **not to exceed 2 pages**)

III. Budget information (entered online at WRI web site)

A. Salaries and wages

B. Fringe benefits (include percentage of grant to be used for faculty salaries, wages, and benefits)

C. Tuition remission charges (if applicable).

D. Supplies and publication costs: list office, laboratory, computer and field supplies separately.

E. Travel to support field operations only. Travel to meetings is excluded because of the limited funding.

F. Other costs: e.g., equipment maintenance and fabrication, subcontracts, rentals, etc.

G. Total direct costs.

PROPOSAL GUIDELINE CHECKLIST

ITEM	GUIDELINE	THIS PROPOSAL
GENERAL PRESENTATION		
Font	Minimum of 11 point	
Margins	Minimum of 0.75"	
PAGE LIMITATIONS		
Project Summary	Maximum of 2 pages	
Narrative and supplements	Maximum of 10 pages	
Curriculum Vitae	Maximum of 4 pages total and 2 for 1 P.I.	
Current and Pending Support	Maximum of 2 pages	
Entire Proposal	Maximum of 18 pages	
PAGINATION		
Project Summary	Page 1 and 2	
Narrative and supplements	Begin on new page, paginate starting at 3	
Curriculum Vitae	Begin on new page, paginate consecutively	
Current and Pending Support	Begin on new page, paginate consecutively	
LINE SPACING		
Project Summary	Double spaced	
Narrative Body	Double spaced	
Figure Legends	Single spaced	
Tables / Titles	Single spaced	
Citations	Single within, double between	
Training and Info Transfer	Single spaced	
Curriculum Vitae	No specific guidelines	
Current and Pending Support	No specific guidelines	

**UNIVERSITY OF WISCONSIN SYSTEM (UWS)
PROJECTS FUNDED
THROUGH THE GROUNDWATER RESEARCH ADVISORY COUNCIL**

As part of the joint solicitation for groundwater research proposals, the UWS, through its Water Resources Institute (WRI) and its Groundwater Research Advisory Council, seeks projects of a fundamental or applied nature on any aspect of groundwater research in the natural sciences, engineering, social sciences or law. Projects funded in the current cycle are listed on the WRI web site at <http://wri.wisc.edu>. The UWS has approximately \$105,000 available in FY 03 to fund new projects. The remainder of the UWS groundwater research funds has been committed to ongoing projects for FY 02.

Applicant Requirements: Most often the principal investigator will be a faculty member on any campus in the UWS. However, academic staff who has achieved nomination to P.I. status by endorsement of the relevant academic dean may serve in this capacity. Projects that appear to be continuations of a previously funded project with two years of UWS support and projects that have been twice rejected will not be considered. The UWS also strives to avoid funding situations where a P.I or co-P.I.'s name appears on more than two UWS projects during any given fiscal year.

Budget Considerations: Projects will not be approved in any one budget cycle for a period of more than two years and then contingent on satisfactory progress. No capital equipment (more than \$5,000 per item) may be purchased. Travel for attendance at scientific meetings will not be accepted. Faculty salaries and fringe benefits to be paid from any project may not exceed 10% of the total individual grant (including fringe benefits). Overhead costs are not allowed. Supplies should not exceed 20% of individual grant.

Review of Proposals: Most recent literature citations are absolutely required for all proposals seeking support from the UWS. Funding decisions are based on ratings by GCC subcommittees and reviews solicited from an international list of experts in the field of the proposed work. The GRAC, which consists of university, state agency, and public representatives, meets as a body to discuss the results of the review process and thereupon to recommend a priority list of projects that the UWS should strive to fund in accordance with budgetary resources. A suitable UWS Groundwater Research Program is then assembled by the WRI and submitted to the GCC for approval before the Department of Administration can release UWS research funds upon passage of a State budget.

UWS Groundwater Research Priorities:
(Presented in no particular order of importance.)

- Chemical and biological degradation of pollutants in surface soils, subsoils, and groundwater, including identification, toxicity, and persistence of degradation products.
- Transport of pollutants in soil and groundwater, including elucidation of soil and hydrologic factors controlling movement and development or validation of predictive models.
- Impact of waste, and agricultural (including agricultural feeding operations), industrial, or municipal management practices on groundwater quality.
- Characterization of geologic factors affecting groundwater movement, contamination, and aquifer recharge.
- Interactions of groundwater and surface water including chemical transformations in the hyporheic zone; impacts of groundwater withdrawal on surface waters; influence of groundwater discharge on water

quality and stream biota; and groundwater export of nutrients to surface waters.

- Land-use impacts on wetland quality and the interaction of groundwater with wetlands.
- Examination of the social and economic impacts of groundwater contamination and groundwater protection policies.
- Investigations on the development, understanding, improvement, cost-effectiveness, or utility of innovative biological, chemical or physico-chemical technologies for remediation of contaminated soils and/or groundwater.
- Biological, ecosystem, and human health effects of common groundwater pollutants and development or evaluation of surrogate, cost-effective bioassay systems for risk assessment.
- Field validation of effects of new technologies for on-site waste treatment (septic systems) on groundwater quality.

**DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION (DATCP)
PESTICIDE RESEARCH PROGRAM**

**RESEARCH GRANT PROGRAM FOR FY 03
SOLICITATION OF APPLICATIONS**

The DATCP Pesticide Research Program is administered by the Agricultural Resource Management Division. Applications are invited for grant awards focusing on regulatory issues associated with pesticide use and control. The DATCP has approximately \$55,000 available for FY 03 to fund new projects. Investigators should note that the focus of the DATCP program is on pesticide research, which includes but is not limited to groundwater issues.

Applicant Requirements: Any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research may submit proposals.

Budget Considerations: The Department may award grants not to exceed three years for research projects on the program priorities outlined below.

Review of Proposals: Proposals are reviewed using the process outlined on p. 3. Funding decisions are made by the DATCP Secretary based on recommendations by the Bureau of Agrichemical Management staff who receive input from GCC subcommittee members and experts in the field.

DATCP RESEARCH PRIORITIES FOR FY 03

1) **Evaluation of the Environmental Fate Investigation Strategies and Remediation Alternatives for Contaminated Soil and Water at Pesticide Spill Sites.**

Research should investigate the degradation and movement of pesticides at spill sites, develop criteria on the need for and appropriate extent of remedial actions, and evaluate various methods for investigation and remediation of contaminated soil and water.

2) **Development of Methods for Cleaning Pesticide Mixing/Loading Pads and Disposing of Pesticide Rinsates.**

Projects should evaluate methods of decontaminating pesticide mixing/loading pads and disposing of or treating pesticide-contaminated rinsate water.

3) **Refinement of Application Methods for Pesticides with High Drift Potential to Reduce Environmental and Public Health Problems.**

The research should focus on how different application methods and environmental conditions affect the potential for drift of pesticides such as metham sodium or clomazone.

4) **Evaluation of Factors Influencing the Patterns of Groundwater Contamination by Pesticides and Pesticide Metabolites in Wisconsin.**

This topic involves examining factors which influence pesticide leaching to determine areas of the state that are susceptible to groundwater contamination by specific pesticides.

5) **Use Related Monitoring of Pesticides and Pesticide Metabolites in Groundwater.**

This project should study groundwater contamination by field application of pesticides in key environmental settings such as fractured bedrock areas.

6) **Identification of the Sources of Pesticide Contamination in Groundwater in Rural Areas.**

Methods should be developed and investigations conducted at contaminated well sites to determine if the contamination is due to field use (nonpoint source) or spills or mishandling (point source) of pesticides.

7) **Evaluation of the Economic Feasibility of Various Chemical and Non-Chemical Weed Control Practices.**

This project should develop a methodology for evaluating the economic feasibility of modifying weed control practices and apply it to examples where practices are changed to reduce impacts on groundwater.

8) **Pesticide Use Surveys.**

These projects should conduct detailed pesticide use surveys that complement other data gathering efforts, such as ground and surface water monitoring, to improve the understanding of pesticide related issues.

9) **Use Related Monitoring of Pesticides in Surface Water and the Effect of Management Practices on Contaminant Levels.**

Projects on this topic should determine the impacts of pesticide use practices on surface water quality and evaluate the ability of various management practices, such as stream setbacks, to reduce contamination.

10) **Evaluation of the Effect of Pesticide Use on Endangered Species and their Habitat.**

This topic should explore how the use of specific pesticides affects the habitat and survival of endangered species in Wisconsin and how alternative pest control methods could reduce problems.

11) **Evaluation of Health and Environmental Risks from Commonly Used Lawn Care Pesticides**

This project should evaluate the health risks following applications of lawn care pesticides such as pendimethalin, 2,4-D, dicamba, and MCPP.

12) **Development of Pest Management Techniques that Lead to Efficient Use of Pesticides and Reduce Impacts on the Environment.**

This project should look at ways of reducing pesticide use through integrated pest management, use of alternative pest control strategies, best management practices, or other techniques that promote efficient pesticide use and minimize environmental problems.

**WISCONSIN DEPARTMENT OF NATURAL RESOURCES
GROUNDWATER MANAGEMENT PRACTICE MONITORING PROGRAM**

Management practice monitoring is defined as groundwater monitoring or support activities associated with groundwater monitoring, such as laboratory technique development or geologic resource description, for establishing or improving management practices necessary to meet the state groundwater quality standards of NR 140, Wis. Adm. Code. Approximately \$170,000 will be available to fund new monitoring projects in FY 03 (July 1, 2002 through June 30, 2003). The remainder has been allocated for ongoing monitoring or related projects.

Applicant Requirements. Funds are restricted to use by UWS and state agency contractors. Others may submit proposals if they include a state-affiliated co-principal investigator.

Budget Considerations. Monitoring proposals will be considered for a maximum of two years. Contracts will be approved on an annual basis. Projects costing less than \$35,000 annually will be given greater consideration than more expensive projects. Budget items to be identified should include such things as personnel costs, supplies, equipment, necessary travel, and other appropriate items. The management practice monitoring funds cannot support indirect costs or the purchase of capital equipment.

In preparing the budget be aware of the following contractual requirements.

Contractual Requirements:

- All monitoring wells installed shall meet DNR regulations and approved procedures for installation, construction and documentation (Chap. NR 141, Wis. Adm. Code.)
- For each new monitoring well, a soil boring form (Form 4400-122), a well construction report (Form 4400-113A), and a monitoring well development form (Form 4400-113B) shall be submitted on paper or in a computer format supplied by the DNR.
- For all existing groundwater sample points (monitoring wells, piezometers, and private water supplies) not previously identified in DNR databases, a Groundwater Monitoring Inventory form (Form 3300-67) supplied by the DNR shall be completed and submitted on paper or in computer format.
- All groundwater quality monitoring data shall be submitted in a computer format compatible with the state Groundwater Retrieval Network and shall be reported to the DNR quarterly after the contractor has received the data. The contractor shall verify computerized data.
- All groundwater samples shall be analyzed by a laboratory certified in Wisconsin for that purpose under Chapter NR 149, Wis. Adm. Code.
- The contractor shall request and use labels with Wisconsin Unique Well Numbers from the DNR for wells constructed and/or sampled to allow identification of wells.
- Abandonment of monitoring wells shall be the responsibility of the contractor. Wells shall be abandoned in accordance with DNR regulations (Chap. NR 141, Wis. Adm. Code) and approved procedures upon completion of the project, unless alternative prior arrangements have been made with the DNR. A well abandonment report shall be submitted on Form 3300-5 or in a computer format supplied by the DNR.

- Quarterly project status reports shall be submitted to the project manager within 30 days of the end of each quarter. A final report and a project summary shall be submitted to the project manager within 60 days of the end of the contract period. The final report must contain a thorough discussion of how the results of the project can and should be used by decision-makers. For example, results that could assist local decision-makers with integrating groundwater in Comprehensive Planning activities should be highlighted.

Review of Proposals: All proposals will be reviewed and rated by DNR staff, and the Monitoring & Data Management and Research Subcommittees of the Groundwater Coordinating Council.

Two important criteria in evaluating each proposal are: 1) whether the proposal addresses an emerging issue or a ongoing monitoring need as listed below; and 2) whether the project involves either groundwater monitoring or activities conducted to support groundwater monitoring. Support functions can include, among other things, laboratory analysis technique development, well drilling and construction methodology development, data management and definition of geologic and hydrogeologic conditions for groundwater management purposes. Proposals should contain a clear discussion of the expected practical application of the project results. This will help the reviewer understand the importance of the proposed research, and will ensure that the researcher designs the project with practical application of results in mind.

In making final funding decisions, the DNR's Groundwater Section will formulate its recommendations based on input from all project reviewers and available funds. The Director of the DNR's Bureau of Drinking Water and Groundwater will make the final funding decisions.

Management Practice Monitoring Priorities for FY03

Proposals will be considered for funding that address one or more of the following emerging issues or ongoing monitoring needs.

Emerging Issues

The Research and Monitoring & Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council and Department staff have identified the following emerging issues as being of the highest importance for groundwater monitoring and research for FY 03. Unlike the ongoing priority monitoring topics that follow the emerging issues, these are specific ideas for projects for which state groundwater experts see an immediate need.

Groundwater Withdrawals and Connections to Surface Waters – Recent events (high capacity well permits, aquifer storage and recovery pilot programs, arsenic, and urban growth near recharge areas) have highlighted the need for continued understanding of the implications of groundwater use on groundwater quality, groundwater quantity, and surface water resources. Research is needed in the following areas:

- identification of areas of the state sensitive to groundwater withdrawals;
- quantification of environmental, social and economic impacts of groundwater withdrawals, including projections of groundwater use in NE and SE Wisconsin;
- assessment of and improvements to existing mechanism for determining impacts of withdrawals on public water supplies;
- monitoring of surface and groundwater flow to determine hydrologic connections and pathways between them;
- investigation of the occurrence and causes of aquifer drawdowns that affect surface water features such as springs, streams and wetlands; and

- characterizing groundwater impacts on and contributions to surface water quality, including TMDL development.

Further information on this issue may be obtained by contacting Tim Asplund (608-267-7449).

Natural Attenuation – In September 1996, chapter NR 726 was revised to allow case closure of sites above NR 140 groundwater enforcement standards. A case can be closed above enforcement standards if it is demonstrated that natural attenuation is effectively cleaning up groundwater. Once the site is closed there is a presumption that natural attenuation will continue cleaning up groundwater until enforcement standards are met. There is a need to go back and audit a sub-set of closed sites to determine whether the assumptions made at closure were appropriate. Questions that need to be addressed include 1) Has the plume margin changed since closure and how much? 2) Have contaminant concentrations in groundwater changed since closure and how long will it take to meet enforcement standards? 3) Has land use surrounding the site changed since closure, e.g., have potable wells been installed near the site? 4) Was site closure appropriate? 5) How do contaminant type and aquifer characteristics influence the time frame for natural attenuation? Further information on this issue may be obtained by contacting Mike Lemcke (608-266-2104).

Incorporating Groundwater in Comprehensive Planning - Legislation adopted in 2000 requires all communities that make land use decisions to base those decisions on a comprehensive plan by January 1, 2010. The legislation outlines nine elements that must be included in each comprehensive plan. Groundwater information or issues may be addressed in several of the nine elements. Work is needed to develop an example comprehensive plan that would show how groundwater could be adequately addressed in a comprehensive plan. This will be valuable information for local governments who typically don't have the resources to fully address groundwater issues. For more information, contact Dave Lindorff (608-266-9265).

Pharmaceuticals - Research is needed to determine whether pharmaceuticals are entering Wisconsin's groundwater. Antibiotics and hormones are widely used in medicine. Certain drugs are also used to enhance the health of livestock, swine and poultry. Pharmaceuticals can enter the environment via municipal sewage effluent, private septic tanks, and animal feedlots. Research proposals should address at least one of the following questions: 1) Can commonly used drugs be detected in groundwater? 2) How do antibiotics, hormones, and other pharmaceuticals behave in the environment, e.g. do they leach, how quickly do they breakdown? and 3) What are the most cost-effective analytical methods for pharmaceuticals in water? Further information on this issue may be obtained by contacting Bill Phelps (608-267-7619).

Microbial Pathogens – Research is needed to develop and test cost-effective screening tools that indicate the presence of, and/or quantify microbial pathogens in groundwater. Investigate the incidence and analytical and monitoring techniques for microbial contaminants, including parasites, bacteria, viruses, and microbial indicators in groundwater. Characterize viruses in groundwater sources serving public water systems. Investigate the potential for airborne microbial contamination of wells through construction practices and evaluate possible prevention strategies. Further information on this issue may be obtained by contacting Don Swailes (608-266-7093).

Infiltration of Urban Runoff - As part of the Runoff Management Program Redesign, Wis. Adm. Code Chapter NR 151 has been proposed to encourage infiltration of stormwater and preserve groundwater recharge. There is a need to monitor the impact of stormwater infiltration on groundwater quality including organic compounds, metals, bacteria and viruses to evaluate DNR performance standards for pretreatment and infiltration devices at residential, commercial and industrial sites. In addition, research is needed on the effects of land use on groundwater recharge and potential strategies for increasing infiltration. Further information on this issue can be obtained by contacting Laura Chern (608 266-0126).

Ongoing Needs

The following priority topics for groundwater management practice monitoring represent ongoing needs as determined by the Research and Monitoring & Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council, a number of state agency staff, and university researchers. The list of priorities is not in any specific order. Further information on any of these topics may be obtained by contacting Tim Asplund (608-267-7449).

Arsenic in Groundwater – Serious arsenic problems exist in Wisconsin, especially in the Lower Fox River Valley. Research to further characterize the source, extent, health effects, and treatment is a continuing need. Examples: define the lateral and vertical extent of the arsenic contamination as well as other associated metals and water quality problems; improve understanding of the system geochemistry, including reaction triggers and the mobility of the contaminants released; find solutions to drinking water problems such as well construction/reconstruction options and treatment; and conduct toxicological and risk assessment studies that may be needed to determine impacts on human health and the environment.

Nitrogen Contamination - Conduct site-specific studies to compare the NRCS 590 standard as proposed in ATCP 50 to current management practices. Evaluate the extent of impacts of nitrate contamination on groundwater quality. Examples: monitoring and evaluation of the impacts of animal operations on groundwater; evaluating the effectiveness of Best Management Practices (BMPs) in reducing nitrogen levels in groundwater. Compare methods that can be used to evaluate the groundwater impacts of current farming systems as well as the economic and water quality impacts of alternative farming systems.

Water Quality in the Deep Sandstone Aquifer - Elevated sulfate and total dissolved solids (TDS) have been found in some new deep municipal wells in the Lower Fox River Valley making the wells unusable. In some other existing deep wells as far south as Milwaukee the TDS have been increasing over the years. Naturally occurring radium is also a problem in many of these wells. Research is needed to define the extent of these water-quality problems, to determine the sources of the dissolved constituents, to determine the hydrogeologic processes responsible for mobilizing the constituents, and for developing advice for the design and placement of new wells and the remediation of older wells.

Data Management/Data Integration – Improve existing state methods for managing and integrating groundwater monitoring data. Examples: working with state agencies to identify existing archives of data related to groundwater quality and management practice monitoring (e.g. karst features); developing a framework for a statewide karst feature database.

Health Effects of Groundwater Contaminants - Research is needed to better characterize the impact of contaminated groundwater on public health. Proposals should focus on contaminants that are commonly encountered in public and private drinking water supplies at levels of health concern. Pathogenic microorganisms, toxic chemicals (both naturally-occurring and synthetic), and their metabolites are of interest.

Groundwater Remediation - Evaluate current or developing remediation technologies, with an emphasis on natural attenuation. Examples: comparing the effectiveness of pump & treat versus natural attenuation through modeling by running sensitivity analysis on permeability, electron acceptor availability, contaminant mass in smear zone, and extraction well location; identifying biogeochemical parameters for cost effective evaluation of natural attenuation at petroleum contaminated sites; and determining the utility of natural attenuation for chlorinated compounds.

Pesticide Management – Evaluate pesticide use impacts on groundwater quality. Examples: monitoring to determine if changes in pesticide application procedures and/or tillage practices have significant potential for reducing pesticide impacts on groundwater; evaluation of the extent of groundwater contamination from

agricultural and nonagricultural pesticide use and handling in various geologic settings; monitoring at pesticide loading facilities to evaluate the effectiveness of the facility to protect the surrounding soils and groundwater from contamination; monitoring to identify the soil and geologic conditions under which pesticide contamination is likely to occur.

Wellhead Protection/Source Water Assessments – Evaluate methods for delineation of wellhead protection (WHP) areas in karst and confined settings. Evaluate planning and management strategies to protect groundwater in WHP areas. Investigators should be familiar with the state WHP and Source Water Assessment Program Plans.

Landfill Regulation – Evaluate current or innovative landfill design, operation or monitoring criteria in relation to compliance with groundwater quality standards. Investigate groundwater impacts of closed landfills.

Wastewater Treatment/Disposal – Monitor and evaluate the extent to which current and alternative on-site wastewater (private sewage) systems comply with state groundwater quality standards. Examples: evaluate new onsite wastewater treatment performance as a function of pretreatment, soil depth, texture and structure, and other factors; and monitoring of nitrogen and phosphorus near lakeshore communities. Also monitor different types of wastewater land application and land spreading practices. This would include the landspreading of wastewater byproduct solids, such as sludges and septage, as well as the land application of industrial, agricultural and municipal wastewaters.

Substances of Concern – Evaluate sources, fate, transport and risk to potable wells from substances (man-made and naturally occurring) detected in groundwater. This includes review and evaluation of DNR groundwater databases; identification and sampling of at-risk potable wells; and correlation of land-use and hydrogeology with risk to potable wells from the substances. Substances detected in groundwater requiring an evaluation include, but are not limited to, rhodamine (used as tracer), p-isopropylbenzene (cumene), strontium (non-radioactive), tert-butyl alcohol (TBA) and aluminum.

New Technology - Develop new laboratory or field technology (or new applications of existing technologies) for determining the characteristics of groundwater and geologic formations for management purposes, including downhole monitoring techniques and rapid site assessment.

Resource Definition – Conduct studies to better describe the geologic, hydrogeologic, and geochemical conditions that affect the groundwater quality and quantity in an area of the state. Example: evaluation of groundwater flow and/or contaminant transport in karst areas.

Table 3 - State of Wisconsin Groundwater Monitoring/Research Projects 1986-2002
(Sorted by principal investigator within initial funding year)

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
<u>1986</u>				
Hydrogeological Investigation of VOC Contaminated Private Wells Near Hudson, Wisconsin	Anklam	1986	DNR	31b
Treatment of Cheese Processing Wastewater by Ridge and Furrow Disposal - Nitrogen Transformations	Boyle	1986	DNR	23
A Case Study of Nitrogen Transformations at a Rapid Infiltration System Used for the Disposal of Food Processing Wastewater	Boyle, Hoopes	1986	DNR	17b
Volatile Organic Compounds in Small Community Wastewater Disposal Systems Using Soil Absorption	Boyle, Sonzogni	1986	DNR	5
Investigation of Hydrogeology and Groundwater Geochemistry in the Shallow Fractured Dolomite Aquifer in Door County, Wisconsin	Bradbury	1986-90	DNR	12
Hydrogeology of the Wisconsin River Valley in Marathon County, Wisconsin	Bradbury	1986	DNR	22
The Prediction of Nitrate Contamination Potential Using Known Hydrogeologic Properties	Cherkauer	1986-87	DNR	10
The Effect of Construction, Installation and Development Techniques on the performance of Monitoring Wells in Fine-Grained Glacial Till	Cherkauer, Palmer	1986	DNR	16
Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills	Friedman	1985-87	DNR	4a
Barron County Nitrate Study	Hanson	1986-87	DNR	37
Field Investigation of Groundwater Impacts from Absorption Pond Systems Used for Wastewater Disposal	Hoopes	1985-86	DNR	17a
A Simple Stochastic Model Predicting Conservative Mass Transport Through the Unsaturated Zone into Groundwater	Hoopes	1986	DNR	1
The Use of Groundwater Models to Predict Groundwater Mounding Beneath Proposed Groundwater Gradient Control Systems for Sanitary Landfill Designs	Hoopes	1986	DNR	6
Evaluation Techniques for Groundwater Transport Models	Hoopes	1986	DNR	7
The Occurrence of Volatile Organic Compounds in Wastewater, Sludges and Groundwater at Selected Wastewater Treatment Plants in Wisconsin	Hunger	1985-90	DNR	18

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Groundwater Quality Monitoring - Long Term Effects of Intensive Farming and Sprinkler Irrigation on Groundwater Quality	Kammerer	1986	DNR	15
Fate of Aldicarb Residues in A Groundwater Basin near Plover, Wisconsin	Kraft	1986-87	DNR	3
Monitoring of Volatile Organic Compounds in Tomah, Wisconsin	Krohn	1986, 1989	DNR	31a
Fate and Mobility of Radium-226 in Municipal Wastewater Sludge Following Agricultural Landspreading	Portle	1986	DNR	19
Groundwater Monitoring for Pesticides	Postle	1986-97	DNR	2
Graphical and Statistical Methods to Assess the Effect of Landfills on Groundwater Quality	Potter	1986-87	DNR	14a
Groundwater Quality and Laundromat Wastewater: Summit Lake, Wisconsin	Saltes	1986-88	DNR	29
Filtration Preservation Study of Groundwater Samples	Sauer	1984	DNR	21a
West Bend Road Salt Use and Storage Study	Sucht	1986-91	DNR	8
Environmental Investigation of the City of Two Rivers Landfills, Manitowoc County, Wisconsin	Van Biersel	1986-87	DNR	24
Volatile Organic Compound Contamination of Private Water Supplies Adjacent to Abandoned Landfills in Marathon County	Wittkopf	1986-89	DNR	41
<u>1987</u>				
Plover Area Nitrate Study	Bailey	1987-88	DNR	48
Characterization of Groundwater Impacts at an Above Ground Petroleum Storage Terminal	Becker, Ham	1987	DNR	43
Research and Data Analysis of Groundwater Contamination from Municipal Rapid Infiltration Land Disposal Systems	Boyle, Hoopes, Potter	1987-88	DNR	56
Downward Movement of Water Below Barnyard Grass Filter Strips - Case Studies	Bubenzer, Converse	1987-89	DNR	39
1987 Volatile Organic Compound Testing Project in Rock County, Wisconsin	Holman	1987	DNR	40
Flambeau Paper Sulfite Lagoon Site Contamination Study	Lantz	1987	DNR	30

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Groundwater Survey of Bacterial Contamination Near Rapid Infiltration Wastewater Treatment System	Norenberg, Standridge	1987	DNR	21b
Investigation of Large Scale Subsurface Soil Absorption Systems	Peerenboom	1987	DNR	42
Hydrogeologic Investigation and Groundwater Quality Assessment (Havenswood Landfill)	Singh	1987	DNR	28
Nitrate Contamination in West-Central Wisconsin with Emphasis on Mill Run First Edition Subdivision	Tinker	1987-90	DNR	11
Lead Migration from Contaminated Sites - Door County, Wisconsin	Wiersma, Stieglitz	1987-88	DNR	13
<u>1988</u>				
A Ground Penetrating Radar Study of Water Table Elevation in a Portion of Wisconsin's Central Sand Plain	Anderson (Mary), Bentley	1988	DNR	50
VOC Contamination at Selected Wisconsin Landfills - Sampling Results and Policy Implications	Battista	1988-89	DNR	4b
Assessment of Geologic Controls on Groundwater Flow and Distribution in Precambrian Bedrock, Central Wisconsin, Using Remote Sensing and Geophysical	Brown, Davidson Jr.	1988	DNR	49
Digital Simulation of Solute Transport to Green Bay and Lake Michigan by Groundwater from Door County, Wisconsin	Cherkauer	1988-91	DNR	57
Degradation of Atrazine, Alachlor, Metolachlor in Soils and Aquifer Materials	Chesters	1988-90	DNR	52
Radionuclides in Drinking Water of North central Wisconsin	Dobbins, Fitzgerald	1988-89	DNR	54
Sealing Characteristics of Sodium Bentonite Slurries for Water Wells	Edil	1988	DNR	34
Mutagenic Effects of Selected Toxicants Found in Wisconsin's Groundwater	Meisner, Belluck	1988-89	DNR	38
Mineralogical and Geophysical Monitoring Naturally Occurring Radioactive Elements in Selected Wisconsin Aquifers	Morsky, Taylor	1988	DNR	51
Evaluation of the Effect of Stormwater Disposal on Groundwater	Nienke, Shaw	1988-89	DNR	53
Methods for Determining Compliance with Groundwater Quality Regulations at Waste Disposal Facilities	Potter	1988-89	DNR	14b

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Analytical Determination of Atrazine Alachlor and Their Selected Degradation Products in Contaminated Groundwater: Implication for Wisconsin Groundwater	Sonzogni	1988-89	DNR	47
Lead Contamination Study of Door County	Stoll	1988	DNR	44
Freedman Creek Hydrogeologic Baseline Report	Wilson	1988-89	DNR	45
<u>1989</u>				
Effect of Soil Type on Atrazine and Alachlor Movement Through Unsaturated Zone	Daniel	1989	DATCP/ DNR	62
Effects of Volatile Organic Compounds on Clay Landfill Liner Performance	Edil, Berthouex, Park, Sandstrom	1989	DNR	61
Grade A Dairy Farm Water Well Quality Survey	LeMasters, Doyle	1989	DNR	58
Groundwater Quality Investigation of Selected Townships in Jefferson County, Wisconsin	Madison	1989	DNR	60
Designs for Wellhead Protection in Central Wisconsin	Osborne, Sorenson, Knaak, Mechenich	1989	DNR	63
Pesticide Migration Study	Shaw	1989-90	DNR	55
Optimum Manure Application Rate - Corn Fertility Management and Nitrate Leaching to Groundwater in Sandy Soils	Shaw	1989-90	DNR	71
Subdivision Impacts on Groundwater Quality	Shaw, Ameson, VanRyswyk	1989	DNR	67
Demo of Low Input Strategies for Potato/Vegetable Production in Irrigated Sands	Shaw, Curwen, Kraft, Osborne	1989-90	DNR	59
<u>1990</u>				
A Field Evaluation of Drainage Ditches as Barriers to Contaminant Migration	Bahr, Chambers	1990-91	DNR	75
Incorporation of County Groundwater Inventory Data into the DNR Groundwater Information Network (GIN)	Bohn	1990	DNR	68
Atrazine Contamination of Groundwater in Dane County, Wisconsin	Bradbury, McGrath	1990-91	DATCP/ DNR	64
Sources and Extent of Atrazine Contamination of Groundwater at a Grade A Dairy Farm in Dane County, Wisconsin	Chesters, Levy	1990-91	DATCP/ UWS/DNR	65
Follow Up to the Grade A Dairy Farm Well Water Quality Survey	Cowell, LeMasters	1990	DATCP/ DNR	70

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Report on Bacteriological Water Quality Monitoring of Door County Variance and Special Casing Approval Wells	Hutchinson	1990-91	DNR	72
DNR and DATCP Rural Well Survey	LeMasters	1990	DATCP/ DNR	69
Variation in Hydraulic Conductivity in Sandy Glacial Till: Site Variation Versus Methodology	Mickelson, Bradbury, Rayne	1990-92	DNR/UWS	74
Analytical Determination of Pesticide Metabolites and Carrier Chemicals in Wisconsin Wells	Sonzogni, Eldan, Lawrence	1990	DNR	77
Nitrogen Isotope Monitoring at Unsewered Subdivisions	Tinker	1990	DNR	76
Volatile Organic Chemical Attenuation in Unsaturated Soil Above and Below an Onsite Wastewater Infiltration System	Tyler, Peterson, Sauer	1990-91	DNR/UWS	73
<u>1991</u>				
Integrated Decision Support for Wellhead Protection	Adams, Bensen	1991	UWS	
Role of Mobile Colloids in the Transport of Chemical Contaminants in Groundwaters	Armstrong, Shafer	1991-93	UWS	
On-site Nitrogen Removal Systems Research Demonstration Project: Phase I	Ayres & Assoc.	1991	DILHR	
Evaluation of Potential Phytotoxicity and Crop Residues when Using Sprayer Rinsate as a Portion of the Diluent in Pesticide Spray Mixtures	Binning	1991	DATCP	
To Expand Groundwater Sampling in the Lower Wisconsin River Valley	Cates, Madison, Postle	1991	DNR	78
Renovation of Pesticide Contaminated Rinse Waters	Chesters, Harkin	1991	UWS	
In-situ Removal of Fe, Mn, and Ra from Groundwater	Christensen, Cherkauer	1991	UWS	
Reactions of Chlorohydrocarbons on Clay Surfaces	Fripiat	1991	UWS	
The Biological Impact of Landfill Leachate on Nearby Surface Waters	Geis, Sonzogni, Standridge	1991	DNR	83
Chemical Transport Across a Sediment-Water Interface	Green	1991-92	UWS	
Adsorptive Behavior of Atrazine and Alachlor in Organic-Poor Sediments	Grundl	1991	UWS	
Effect of Complex Mixtures of Leachate on the Transport of Pollutants in Groundwater	Grundl, Cherkauer	1991-92	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Bioremediation of Herbicide-Contaminated Soil and Water	Harris, Armstrong	1991	UWS	
Near-Source Transport of Contaminants in Heterogeneous Media	Hoopes	1991-92	UWS	
Design of a Small Scale Transportable Mixing/Loading System	Kammel	1991	DATCP	
Municipal Wastewater Project	Kopecky	1991	DNR	85
Dependence of Aldicarb Residue Degradation Rates on Groundwater Chemistry in the Wisconsin Central Sands	Kraft, Helmke	1991-92	DNR	84
Using Ground Penetrating Radar to Predict Preferential Solute Movement and Improve Contaminant Monitoring in Sandy Soils	Kung, Madison	1991	UWS	
Nitrate Movement Through the Unsaturated Zone of a Sandy Soil in the Lower Wisconsin River Valley	Lowery, Kussow	1991-93	UWS	
Effect of Soil Type, Selected BMPs, and Tillage on Atrazine and Alachlor Movement Through the Unsaturated Zone	Lowery, McSweeney	1991	DATCP/ DNR	66
A Study of the Response of Nitrate and Pesticide Concentrations to Agricultural BMPs in Sandy Corn Fields	Madison, Cates	1991-94	DNR	81
Facility Plan Amendment for Wastewater Collection for Green Lake Sanitary District, Green Lake, WI	McMahon & Assoc.	1991	DILHR	
Contamination Attenuation Indices for Sandy Soils: Tools for Information Transfer	McSweeney, Madison	1991	UWS	
Tracking Contaminant Pathways in Groundwater Using a Geologically Based Computer Code for Outwash	Mickelson, Anderson	1991-92	UWS	
A Tracer Technique for Measuring Regional Groundwater Velocities from a Single Borehole	Monkmeyer	1991	UWS	
The Economic Effects of Groundwater Contamination on Real Estate	Page	1991	UWS	
Prediction of Organic Chemical Leachate Concentrations from Soil Samples	Park	1991	UWS	
Crop Rotations Effects on Leaching Potential and Groundwater Quality	Posner, Bubenzer, Madison	1991-92	DNR	80
Barnyard Management Practices: Effect on Movement of Nitrogen Through Soils and Impact on Groundwater Quality	Shaw	1991-92	DNR	9

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
A Comparative Study of Nitrate-N Loading to Groundwater from Mound, In Ground Pressure and at Grade Septic Systems	Shaw, Turyk	1991-92	DNR	82
Waupaca County Groundwater Project: Towns of St. Lawrence and Little Wolf	Wilson, Blonde	1991	DNR	79a
<u>1992</u>				
Effects of Transient Cross-Stratification Flow on Contaminant Dispersion	Bahr	1992-93	UWS	
Geographical Information System for Subsurface Characterization	Bosscher, Adams	1992-93	UWS	
Distribution of Radionuclides in Wisconsin Groundwater	Bradbury, Mudrey	1992	DNR	91
Evaluation of NURE Hydrogeochemical Groundwater Data for Use in Wisconsin Groundwater Studies	Bradbury, Mudrey, Shrawder	1992	DNR	90
Preliminary Comparison of a Discrete Fracture Model with a Continuum Model for Groundwater Movement in Fractured Dolomite	Bradbury, Muldoon	1992	DNR	89
GIS Mapping of Groundwater Contaminant Sources, Quality and Contamination Susceptibility for Door County	Carlson, Stoll, Hronek	1992-93	DNR	93
Distribution, Transport and Fate of Major Herbicides and Their Metabolites	Chesters	1992-93	UWS/DATCP	
Dane County Atrazine/Land Management Project	Conners, Bohn, Madison, Muldoon, Richardson	1992	DATCP/ DNR	99
Use of Tire Chips to Attenuate VOCs	Edil, Park	1992-93	UWS	
Municipal Wastewater Absorption Pond Renovation for Enhanced Nitrogen Removal	Gilbert	1992-93	DNR	97
Living Mulch Systems for Nitrate Trapping in Vegetable Production	Harrison	1992-93	UWS	
Remediation of Soils Contaminated by Leaking Underground Storage Tanks by Vapor Extraction and In-situ Biostimulation	Hickey, Jacobsen, Bubenzer	1992-93	DNR	96
Herbicide and Nitrate Movement in a Sandy Soil in the Lower Wisconsin River Valley	Lowery, McSweeney	1992-93	UWS/DATCP	
Spatial Attributes of the Soil-Landscape-Groundwater System of the Lower Wisconsin River Valley	McSweeney, Madison, Attig, Bohn, Falk	1992-93	DNR	88

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Nitrogen Removal from Domestic Wastewater in Unsewered Areas	Otis, Converse	1992-96	DILHR	
New Approaches to Measuring Biologic Effects of Groundwater Contaminants	Porter	1992	UWS	
Estimating the Spatial Distribution of Groundwater Recharge Rates Using Hydrologic, Hydrogeologic and Geochemical Methods	Potter	1992-93	UWS/DATCP	
Investigation of Potential Groundwater Impacts at Demolition Landfills and Deer Pits	Pugh, Connelly	1992-93	DNR	98a
Assessment of Wisconsin's Groundwater Monitoring Plan Program for Active Non-Approved Landfills (1985-1990)	Pugh, Gear	1992	DNR	92
Evaluation of Denitrification Systems for Improving Groundwater from On-Site Waste Disposal Systems	Shaw	1992-93	DNR	95a
Arsenic as a Naturally Elevated Parameter in Water Supply Wells in Eastern Winnebago and Outagamie Counties	Stoll	1992	DNR	87
Waupaca County: Towns of Lebanon and Scandinavia	Wilson, Blonde	1992	DNR	79b
<u>1993</u>				
Urban Stormwater Infiltration: Assessment and Enhancement of Pollutant Removal	Armstrong	1993-94	DNR	102
Trace Metal Transport Affected by Groundwater Stream Interactions	Bahr	1993-94	UWS	
Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite	Bradbury, Muldoon	1993-94	DNR	101
Evaluation of Five Groundwater Susceptibility Assessments in Dane County, Wisconsin	Bridson, Bohn	1993-94	DNR	100
Management of Sweet Corn Processing Wastes to Protect Groundwater Quality	Bundy	1993-94	UWS	
Impact of Tunnel Dewatering on Surface Water Bodies in Milwaukee County	Cherkauer	1993-94	UWS	
A Further Study of Organics at Wisconsin Municipal Solid Waste Landfills	Connelly	1993-94	DNR	104
Ultrasonic Verification Technique for Evaluating Well Seals	Edil	1993-94	UWS	
Long-Term Transformation and Fate of Nitrogen with Mound Type Soil Absorption Systems for Septic Tank Effluent	Harkin	1993-94	DNR	103

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Field Evaluation of Near Source Transport of Contaminants in Heterogeneous Media	Hoopes	1993-94	UWS	
Variability of Hydraulic Conductivity in Supraglacial Sediments	Mickelson	1993-94	UWS	
The Impact of Atrazine Management Areas Designation on Weed Control Strategies in Wisconsin Corn Production	Nowak	1993	DATCP	
<u>1994</u>				
Photocatalytic degradation of volatile organic carbon	Anderson (Marc)	1994-95	UWS	94REM2B2
Improved design of pump and treat systems for heterogeneous aquifers	Bahr	1994-95	UWS	94REM3B2
Herbicide contamination of soil and groundwater at a mixing and loading site	Chesters	1994-95	UWS/ DATCP	94PES2B2
An Investigation of Field-Filtering and Low-Flow Pumping When Sampling for Metals	Connelly	1994	DNR	106
Mineral phase sorption of selected agrichemicals to Wisconsin Soils	Grundl	1994-95	UWS	94PES1B2
Stratigraphy, sedimentology, and porosity distribution of the Silurian rocks of the Door Peninsula, Wisconsin	Harris	1994-95	UWS	94HGE2B2
Using 'PREDICT' to reduce herbicide usage and improve groundwater quality	Harvey	1994-95	UWS	94PES6B2
Comparative evaluation of biostimulation approaches for enhancing in situ TCE degradation in contaminated aquifers	Hickey	1994-95	UWS	94REM6B2
Leaching Potential of Imazethapyr and Nicosulfuron in Sparta Sand	Lowery	1994	DATCP	
Cover Crops to Limit Herbicide Use on Sweet Corn	Newenhouse	1994	DATCP	
Groundwater Hydrogeology of an Agricultural Watershed	Potter	1994-95	DATCP/ DNR	109
Investigation of Potential Groundwater Impacts at Yard Waste Sites	Pugh, Connelly	1994	DNR	98b
Optimization of Two Recirculating Sand Filters for Nitrogen and Organic Chemical Removal from Domestic Wastewater	Shaw	1994	DNR	95b
Factors Affecting the Determination of Radon in Groundwater	Sonzogni	1994	DNR	111

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Integrated Computerized Mapping of Point Source Contaminants and Physical Environmental Characteristics to Protect and Manage Groundwater Quality	Stoll	1994	DNR	105
The Further Incidence of Native Arsenic in Eastern Wisconsin Water Supply Wells; Marinette, Oconto, Shawano and Brown Counties	Stoll	1994	DNR	110
Groundwater Survey of Alachlor and ESA its Polar Metabolite in Southern Wisconsin	Vanden Brook, Postle	1994	DATCP/ DNR	112
The Use of Peat as an Absorptive Medium	Wiersma, Stieglitz	1994	DATCP	

1995

Evaluating the Effectiveness of Landfill Liners	Benson	1995-96	UWS	
Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite	Bradbury	1995-96	UWS	
Application of a Discrete Fracture Flow Model for Wellhead Protection at Sturgeon Bay, Wisconsin	Bradbury, Muldoon	1995-96	DNR	113
Direct and Residual Effects of Land-applied Sweet Corn Processing Wastes on Nitrate Loss to Groundwater	Bundy	1995-96	DNR	120
Integration of Hydraulics and Geology into a Hydrostratigraphic Model for the Paleozoic Aquifer of Eastern Dane County, Wisconsin	Cherkauer	1995	UWS	
A Comparison of Low Flow Pumping and Bailing for VOC Sampling	Connelly	1995	DNR	114
A Low-Input Crop Management Plan for Wisconsin Fresh-Market Vegetable Growers	Delahaut	1995	DATCP	
Use of Heavy Nitrogen to Study Nitrate Flux from Septic Systems	Harkin	1995-96	UWS/Comm	
Agrichemical Impacts to Groundwater Under Irrigated Vegetables in the Central Sand Plain	Kraft	1995-96	DNR	116
Vertical and Horizontal Variability of Hydrogeologic Properties in Glaciated Landscapes	Mickelson	1995	DNR	119
Synergistic Effects of Endocrine Disrupters in Drinking Water	Porter	1995-96	UWS	
Development and Demonstration of an Accurate Manure Spreading System to Protect Water Quality, Improve Waste Management and Farm Profitability	Shinners	1995-96	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Geologic Constraints on Arsenic in Groundwater with Applications to Groundwater Modeling	Simo	1995	UWS	
Characterization of E. Coli and Total Coliform Organisms Isolated from Wisconsin Groundwater and Reassessment of their Public Health Significance	Sonzogni	1995	DNR	117
Evaluation of Enzyme-linked Immunosorbent Assay for Herbicide Analysis of Wisconsin Soil in Comparison to Gas Chromatography	Sonzogni	1995	UWS	
An Evaluation of Long-term Trends and a Mineralogical Interpretation of Naturally Occurring Metals Contamination and Acidification of the	Weissbach	1995-96	DNR	115
Collection of Hydraulic and Geologic Data to Improve the Quality of the Wisconsin Groundwater Monitoring Network	Zaporozec	1995-96	DNR	118
<u>1996</u>				
Bioremediation of Hydrocarbons Influenced by Air Sparging: A Multi-model Approach to Assess Contaminant Mass Removal	Bahr	1996	UWS	
Delineation of Capture Zones for Municipal Wells in Dane County, Wisconsin	Bradbury	1996	DNR	121
Responses of Biological Toxicity Tests to Mixtures of Pesticides and Metabolites	Chesters	1996-97	UWS	
Evaluation of Well Seals Using an Ultrasonic Probe	Edil	1996	UWS	
Iron-based Abiotic Destruction of Chlorinated Solvents and Pesticides in Groundwater	Eykholt	1996	DATCP	
Biostimulation of Trichloroethylene Degradation in Contaminated Aquifers	Hickey	1996	UWS	
Optimum Management of Ground-water Resources in the Lower Fox River Valley	Krohelski	1996-97	DNR	122
Variability of Nitrate Loading and Determination of Monitoring Frequency for a Shallow Sandy Aquifer, Arena, Wisconsin	Madison	1996-97	DNR	123
Characterization of the Role of Evapotranspiration on Groundwater Movement and Solute Chemistry in Groundwater-fed Wetlands	Potter	1996-97	UWS	
Ground-water Recharge and Contamination in Wisconsin's Driftless Area	Potter	1996	DATCP	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Land Use Effects on Groundwater and Streamwater Quality in the Little Plover River Watershed	Shaw	1996-97	DATCP	
Stratigraphic Controls on the Mobilization and Transport of Naturally Occurring Arsenic in Groundwater: Implication for Wellhead Protection in	Simo	1996	UWS	
Evaluation of Shallow-soil Absorption Fields Associated with Advanced On-site Disposal System	Stieglitz	1996-97	DNR/UWS Comm	125
GIS as a Tool to Prioritize Environmental Releases, Integrate their Management, and Alleviate their Public Threat	Stoll	1996-97	DNR	126
The Use of Azimuthal Resistivity & Self Potential Measurements to Delineate Groundwater Flow Direction in Fractured Media	Taylor	1996	UWS	
An Integrated Approach to the Management of Insects in Sweet Corn Grown for Fresh Market	Wedberg	1996-97	DATCP	

1997

Improved Estimation of Groundwater Recharge Rates	Anderson (Mary)	1997	UWS	
Hydrogeochemical and Microbiological Studies for Enhanced Ground Water Bioremediation	Bahr	1997-98	UWS	
In situ Air Sparging: Air Plume Characterization and Removal Effectiveness	Benson	1997-98	UWS	
Groundwater Protection by Application of Modern Portfolio Theory to Microbiotesting Strategies	Blondin	1997	UWS	
Holding Tank Effluent and Fecal-Contaminated Groundwater: Sources of Infectious Diarrhea in Central Wisconsin?	Borchardt	1997-98	Comm	
Development of a Variable Rate Nitrogen Application Approach for Corn	Bundy	1997-98	UWS	
Groundwater Bioremediation: Monitoring with MMO Probes	Collins	1997-98	UWS	
Experimental Verification of Models Used to Evaluate Landfill Liner Effectiveness	Edil	1997	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Stratigraphy, sedimentology, and Porosity Distribution of the Silurian Aquifer of Ozaukee County, Wisconsin	Harris	1997	UWS	
Molecular Techniques for Detection and Identification of Sewage-Borne Human Pathogens in Soils	Hickey	1997-98	Comm	
Nitrate-Contaminated Drinking Water Followback Study	Kanarek	1997	DNR	131
Fate of Nicosulfuron in Sparta Sand	Lowery	1997	DATCP	
Treatment of Groundwater Contaminated with Chlorinated Aliphatics Using a Silicone Tubing Supported Methanotrophic Biofilm Reactor	Park	1997-98	UWS	
Evaluation of the Use of DUMPSTAT to Detect the Impact of Landfills on Groundwater Quality	Potter	1997	DNR	130
Stratigraphic Controls on Distribution of Hydraulic Conductivity in Carbonate Aquifers	Simo	1997-98	DNR	129
Improved Detection Limits for Ground Water Monitoring	Sonzogni	1997	DNR/UWS	128
Determining Compatibility Between Herbicide Release and Habitat for Karner Blue Butterfly in Red Pine Plantations	Sucoff	1997	DATCP	
A Study of Well Construction Guidance for Arsenic Contamination in Northeast Wisconsin	Weissbach	1997-98	DNR	127
<u>1998</u>				
Assessment of Impacts on Groundwater/Lake and Wetland Systems	Anderson (Mary)	1998	UWS	
Groundwater-Surface Water Interactions in the Nine Springs Watershed	Bahr	1998-99	DNR	137
Evaluation of the Confining Properties of the Maquoketa Formation in the SEWRPC Region of Southeastern Wisconsin	Bradbury	1998	DNR	138
Watershed-Scale Nitrate Contamination and Chlorofluorocarbon Ages in the Little Plover Basin: A Study at the Groundwater/Surface Water Interface	Browne	1998-99	UWS	
Determining Ground-Water Recharge Rates in Southern Washington County	Cherkauer	1998-99	UWS	
Characterization of the Hydrostratigraphy of the Deep Sandstone Aquifer in Southeastern Wisconsin	Eaton	1998-99	DNR	134

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Further Evaluation of Well Seals Using an Ultrasonic Probe	Edil	1998	DNR	136
Evaluation of Exploration Borehole Seals Using Time Domain Reflectometry (TDR)	Edil	1998-99	UWS	
Fate of Metolachlor, Alachlor, and Nitrate in Granular Iron/Soil/Water Systems,	Eykholt, Davenport, Wonsettler	1998	DATCP	
Investigation of Air Sparging: Numerical Modeling, Laboratory Verification and Design Guidelines	Hoopes	1998-99	UWS	
The Direct Effect of Agricultural Chemicals on Wisconsin's Declining and Endangered Amphibians	Karasov	1998-99	UWS/DATCP	
Relationships Between Water Quality in Stream Base Flow and Private Wells and Land use in the Tomorrow/Waupaca River Watershed	Shaw	1998-99	DNR	132
Impact of Ginseng Production on Groundwater Quality,	Shaw, De Vita	1998	DATCP	
Northeast Region Public Water Supply Location Utilizing Geographic Information Systems and Global Positioning Systems	Stoll	1998	DNR	133
Effects of Fosamine, Picloram, and Triclopyr on Reducing Aspen in Prairie Bush Clover Habitat,	West	1998	DATCP	
Evaluation of Geology and Hydraulic Performance of Wisconsin Ground-Water Monitoring Wells	Zaporozec	1998	DNR	135
<u>1999</u>				
On-line SFE/GC for Improved Detection of Trace Organic Pollutants in Ground Water Monitoring	Armstrong	1999	UWS/DATCP	
A Rational Design Approach for Permeable Reactive Walls	Benson	1999-2000	UWS	
Viral Contamination of Household Wells Near Disposal Sites for Human Excreta	Borchardt, Sonzogni	1999-2000	DNR	144
Groundwater Flow and Heat Transport in Wetlands: Transient Simulations and Frequency-Domain Analysis	Bravo	1999-2000	UWS	
Monitoring: Evaluation of the Abundance, Diversity, and Activity of Methanotroph Populations in Groundwater	Collins	1999-2000	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Mechanical Controls on Fracture Development in Carbonate Aquifers: Implications for Groundwater Flow Systems	Cooke	1999-2000	DNR	142
Acute and Chronic Toxicity of Nitrate to Brook Trout (<i>Salvelinus fontinalis</i>)	Crunkilton	1999-2000	DNR	140
Maquoketa Shale as Radium Source to the Cambro-Ordovician Aquifer System	Grundl	1999-2000	DNR	141
Sedimentology, Stratigraphy, and Porosity-Conductivity Relations of the Silurian Aquifer of Ozaukee County, Wisconsin	Harris	1999-2000	UWS	
Analysis of Microbiological and Geochemical Processes Controlling Biodegradation of Aromatic Hydrocarbons in Anaerobic Aquifers	Hickey	1999-2000	DNR	143
Assessing and Reducing Leaching of Agricultural Chemicals on Silt Loam Soils under Different Farming Systems	Kung	1999-2000	DATCP	
Using Geographic Information Systems and Soil Landscape Models to Predict Critical Sites for Nonpoint Source Pollution	Lowery	1999-2000	DATCP	
Water and Land Use: Interpretation of Existing Data to Foster Constructive Public Dialogue and Policy Formulation	Read	1999	UWS	
Natural Attenuation of Fuel and Related Groundwater Contaminants - A Measurement Method	Sonzogni	1999	UWS	
Fate of the Herbicides Atrazine, Cyanazine, and Alachlor and Selected Metabolites	Stoltenberg	1999	DATCP	
Hydraulic Conductivity and Specific Storage of Maquoketa Shale	Wang	1999	UWS	

2000

A groundwater model for the Central Sands of Wisconsin: Assessing the environmental and economic impacts of Irrigated agriculture	Anderson (Martha), Bland, Kraft	2000	DATCP/ DNR	146
Remediating groundwater using reactive walls containing waste foundry sands	Benson, Eykholt	2000-01	DNR/UWS	147
Field verification of capture zones for municipal wells at Sturgeon Bay, Wisconsin	Bradbury, Rayne, Muldoon	2000	DNR	148
Refinement of two methods for estimation of groundwater recharge rates	Bradbury, Anderson, Potter	2000	DNR	150

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Causes of historical changes in ground-water recharge rates in southeastern Wisconsin	Cherkauer	2000-01	UWS	
Evaluating options for changing groundwater and leachate monitoring requirements for landfills to reduce mercury used by laboratories	Connelly, Stephens, Shaw	2000-01	DNR	151
Compatibility of containment systems with mine waste liquids	Edil, Benson	2000-01	UWS	
Time domain electromagnetic induction survey of eastern Waukesha County and selected locations	Jansen, Taylor	2000	UWS	
Admicelle-catalyzed reductive dechlorination of PCE by zero valent iron	Li	2000-01	UWS	
Development of neural network models for predicting nitrate concentration in well water	Lin, Shaw	2000-01	UWS	
Field monitoring of drainage and nitrate leaching from managed and unmanaged ecosystems	Norman, Brye	2000-01	UWS	
Macropore flow: A means for enhancing groundwater recharge or a potential source of groundwater contamination	Potter, Bosscher	2000-01	UWS	
Hydraulic Conductivity and Specific Storage of Maquoketa Shale	Wang	2000	UWS	
Improvement of Wisconsin groundwater monitoring network	Zaporozec	2000	DNR	149
<u>2001</u>				
Development of analytical methods for comprehensive chemical and physical speciation of arsenicals in groundwater	Aldstadt	2001-02	DNR	154
Removal of As(III) and As(V) in Contaminated Groundwater with Thin-Film Microporous Oxide Adsorbents	Anderson (Marc)	2001-02	UWS	
The Spatial and Temporal Variability of Groundwater Recharge	Anderson (Mary), Potter	2001	UWS	
Importance of Groundwater in Production and Transport of Methyl Mercury in Lake Superior Tributaries	Armstrong	2001-02	UWS	
A study of microbiological testing of well water quality in Door County and incidence of illness in humans	Braatz	2001	DNR	159
A Basin-Scale Denitrification Budget for a Nitrate Contaminated Wisconsin Aquifer: A Study at the Groundwater/Surface Water Interface	Browne, Kraft	2001-02	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
New approaches to the assessment of microbes in groundwater: application to monitoring bioremediation and detection of pathogens	Collins	2001-02	DNR	155
VOC trend analysis of WI solid waste landfill monitoring data: A preliminary analysis of the natural attenuation process	Connelly	2001-02	DNR	153
Evaluation of pathogen and nitrogen movement beneath on-site systems receiving domestic effluent from single pass sand filters	Converse	2001	Comm	
Effectiveness of phytoremediation and hydrogeologic response at an agricultural chemical facility in Bancroft, WI	DeVita, Dawson	2001-02	DATCP	
Effect of Clean and Polluted Groundwater on Daphnia Reproduction and Development	Dodson	2001-02	UWS	
Verification and characterization of a fracture network within the Maquoketa shale confining unit, SE Wisconsin	Eaton	2001	DNR	157
Groundwater Modeling: Semi-Analytical Approaches for Heterogeneity and Reaction Networks	Eykholt	2001	UWS	
Geologic and geochemical controls on arsenic in groundwater in northeastern Wisconsin	Gotkowitz	2001-02	DNR	152
Screening of agricultural and lawn care pesticides for developmental toxicity using the mouse embryo assay	Greenlee	2001	DATCP	
Public health impacts of arsenic contaminated drinking water	Knobeloch	2001-02	DNR	158
Pesticide and nitrate leaching in soils receiving manure	Lowery, Arriaga, Stoltenberg	2001	DATCP	
An analysis of arsenic replacement wells to determine validity of current DNR well construction guidance	O'Connor	2001-02	DNR	156
Remediation of Soil and Groundwater Using Effectively and Ineffectively Nodulated Alfalfa	Turyk, Shaw	2001-02	UWS/DATCP	
<u>2002</u>				
Groundwater-lake interaction: Response to climate change Vilas County, Wisconsin	Anderson (Mary)	2002	UWS	02-GSI-1
Impacts of privately-sewered subdivisions on groundwater quality in Dane County, WI	Bradbury	2002-3	UWS	02-OSW-1
Chloroacetanilide and atrazine residue penetration and accumulation in two Wisconsin groundwater basins	DeVita, McGinley, Kraft	2002-3	DATCP	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Effect of clean and polluted groundwater on reproduction and development of <i>Daphnia</i>	Dodson	2002	UWS	02-BEP-1
Monitoring Contaminant Flux from a Stormwater Infiltration Facility to Groundwater	Dunning, Bannerman	2002-3	DNR	168
Removal of heavy metals and radionuclides from soils using cationic surfactant flushing	Evans, Li	2002-3	UWS	02-REM-3
Impacts of land use and groundwater flow on the temperature of WI trout streams	Gaffield, Wang	2002-3	UWS	02-GSI-3
Delineation of high salinity conditions in the Cambro-Ordovician aquifer of eastern Wisconsin	Grundl, Taylor	2002	DNR	170
Investigation of changing hydrologic conditions of the Coon Creek watershed in the driftless area of Wisconsin	Hunt	2002	UWS	02-GSI-2
Susceptibility of La Crosse municipal wells to enteric virus contamination from surface water contributions	Hunt, Borchardt	2002	DNR	165
Occurrence of antibiotics in wastewater effluents and their mobility in soils. A case study for Wisconsin	Karthikeyan, Bleam	2002-3	DATCP/ DNR	169
Nitrate loading history, fate, and origin for two Wisconsin groundwater basins	Kraft	2002-03	DNR	171
Monitoring and Scaling of Water Quality in the Tomorrow-Waupaca Watershed	Lin, Browne	2002-3	UWS	02-SAM-1
Co-occurrence and removal of arsenic and iron in groundwater	McGinley	2002-3	UWS	02-REM-2
Agrochemical leaching from sub-optimal, optimal, and excessive manure-N fertilization of corn agroecosystems	Norman, Brye	2002-3	DATCP	
Removal of arsenic in groundwater using novel mesoporous sorbent	Park	2002-3	UWS	02-REM-5
Field evaluation of raingardens as a method for enhancing groundwater recharge	Potter	2002-3	UWS	02-BMP-1
Importance of disinfection on arsenic release from wells	Sonzogni, Bowman Standridge, Clary	2002-3	DNR	172
Preservation and survival of <i>E. coli</i> in well water samples submitted for routine analyses	Sonzogni, Standridge, Bussen	2002	DNR	173
Development of a culture method for detection of <i>Helicobacter pylori</i> in groundwater	Sonzogni, Standridge, Degnan	2002	DNR	167
Time domain electromagnetic induction survey of the sandstone aquifer in the Lake Winnebago area	Taylor, Jansen	2002	DNR	173

WISCONSIN FERTILIZER RESEARCH PROGRAM

The Wisconsin Fertilizer Research Program is a state-wide funding source for applied agricultural research. Funding criteria contained in the law states that funds shall be forwarded to the University of Wisconsin to be used "for research on soil management, soil fertility, plant nutrition problems and for research on surface water and ground water problems which may be related to fertilizer usage; for dissemination of the results of the research; and for other designated activities tending to promote the correct usage of fertilizer materials."

Fertilizer Research Program objectives are:

- 1) To gain knowledge on fertilizer efficiency, plant nutrition, and groundwater and surface water protection that can improve agricultural profitability and protect resources.
- 2) To provide information for Wisconsin farmers that can be used for making wise decisions regarding fertilizer use in Wisconsin.

The Fertilizer Research Council resides in the Department of Agriculture, Trade and Consumer Protection. The Council nonvoting members are the Secretary of Agriculture, Trade and Consumer Protection, the Secretary of Natural Resources, and the Dean of the College of Agricultural and Life Sciences at the University of Wisconsin-Madison, or their representatives. The Council has seven voting members: three members are industry representatives selected from a list of candidates provided by the fertilizer industry; three members are farmers who are crop producers; and one member serves as a water quality expert. All members are volunteers, and serve no more than two consecutive 3-year terms. The Council is responsible for recommending projects to be financed by fertilizer research funds. The Council members meet annually to select projects to recommend for funding. Recommendations are made by a majority vote of the Council.

Projects funded in FY 2001 and projects selected for funding in FY 2002 are listed in the following tables.

RESEARCH PROJECTS FUNDED BY THE FERTILIZER RESEARCH COUNCIL FOR FY 02

Project Number	PI	Title	Funding
191-01	Bundy	Manure Management and History Effects on Phosphorus Losses in Runoff from Land-Applied Manure in Corn Production	\$15,130.00
192-01	Roper	Reducing Phosphorus Fertilizer Application to Cranberry Beds	\$2,350.00
195-01	Cooper band	Water availability of phosphorus from animal manures and P fertilizers applied to soils	\$25,919.00
190-00	Kelling	Evaluation of Dairy Manure Use in Potato Production Systems	\$9,600.00
189-00	Kelling	Effect of Stand Age on Alfalfa Response to N and/or S and Confirmation of Alfalfa needs in WI	\$7,900.00
188-00	Li	Use of Surfactant Modified Zeolite as Fertilizer Additive to control nitrate sulfate and phosphate release	\$8,307.00
186-00	Bundy	Evaluating Benefits from Over-winter Cover Crops	\$11,520.00
185-99	Kelling	Investigations into Improved N Use Efficiency in Potatoes	\$ 9,000.00
184-99	Kelling	Interaction of Soil pH and Rate of Topdressed K on Alfalfa Forage Mineral Levels, Yield, and Quality	\$11,000.00
177-99	Bundy	P Losses in Runoff from WI Soils	\$8,650.00
175-99	Bundy	N-Application Effects on Residue Decomposition and No-till Corn Yields	\$10,000.00
172-99	Kelling	Effect of Tillage and Timing on Legume N Mineralization and N Credit to Small Grains	\$9,900.00
91	Kelling	Evaluation of Certain non-conventional soil additives	\$5,000.00

RESEARCH PROJECTS FUNDED BY THE FERTILIZER RESEARCH COUNCIL FOR FY 03

Project Number	PI	Title	Funding
114-90	Dr. Keith Kelling UW-Soil Science	Evaluation of Certain non-conventional soil additives	\$4,000.00
185-99	Dr. Keith Kelling UW-Soil Science	Investigations into Improved N Use Efficiency in Potatoes	\$8,500.00
186-00	Dr. Larry Bundy UW-Soil Science	Evaluating Benefits from Over-wintering Cover Crops	\$11,920.00
190-00	Dr. Keith Kelling UW-Soil Science	Evaluation of Dairy Manure Use in Potato Production Systems	\$9,600.00
191-01	Dr. Larry Bundy UW-Soil Science	Manure Management and History Effects on Phosphorus Losses in Runoff from Land-Applied Manure in Corn Production	\$15,720.00
192-01	Dr. Teryl Roper UW-Horticulture	Reducing Phosphorus Fertilizer Application to Cranberry Beds	\$2,350.00
196-02	Dr. K.G. Karthikeyan UW-BSE	Phosphorus Dynamics in Soils Receiving Chemically Treated Dairy Manure	\$17,125.00
197-02	Dr. Shawn Kaeppler UW-Agronomy	Maize hybrid response to P fertilization: Analysis of genotypes with divergent root traits, P efficiency, and mycorrhizal responsiveness	\$10,000.00
198-02	Dr. Wayne Kussow UW-Soil Science	Soil Test Selection and Calibration for Turf	\$9,344.00
TOTAL			\$88,559.00

STATUTORY LANGUAGE RELATING TO THE GCC

SECTION 2. 15.347 (13) of the statutes is created to read:

15.347 (13) Groundwater Coordinating Council. (a) *Creation*. There is created a groundwater coordinating council, attached to the department of natural resources under s. 15.03. The council shall perform the functions specified under s. 160.50.

(b) *Members*. The groundwater coordinating council shall consist of the following members:

1. The secretary of natural resources.
2. The secretary of industry, labor and human relations.
3. The secretary of agriculture, trade and consumer protection.
4. The secretary of health and social services.
5. The secretary of transportation.
6. The president of the university of Wisconsin.
7. The state geologist.
8. One person to represent the governor.
9. ~~One person who is a member of a local health department under s. 149.09, appointed by the governor to represent local health departments.~~ (Vetoed in part)

c) *Designees*. Under par.(b), agency heads may appoint designees to serve on the council, if the designee is an employe or appointive officer of the agency who has sufficient authority to deploy agency resources and directly influence agency decision making.

d) *Terms*. Members appointed under par. (b) 8 ~~and 9~~ shall be appointed to 4-year terms. (Vetoed in part)

e) *Staff*. The state agencies with membership on the council and its subcommittees shall provide adequate staff to conduct the functions of the council.

f) *Meetings*. The council shall meet at least twice each year and may meet at other times on the call of 3 of its members. Section 15.09 (3) does not apply to meetings of the council.

g) *Annual report*. In August of each year the council shall submit to the head of each agency with membership on the council, the members of appropriate standing committees of the legislature and the governor, a report which summarizes the operations and activities of the council during the fiscal year concluded on the preceding June 30, describes the state of the groundwater resource and its management and sets forth the recommendations of the council. The annual report shall include a description of the current groundwater quality in the state, an assessment of groundwater management programs, information on the implementation of ch. 160 and a list and description of current and anticipated groundwater problems. In each annual report, the council shall include the dissents of any council member to the activities and recommendations of the council.

Non-statutory provisions: Natural Resources

(9) GROUNDWATER COORDINATING COUNCIL: INITIAL APPOINTMENTS. (a) Notwithstanding section 15.347 (13)(d) of the statutes, as created by this act, the initial member appointed to the groundwater coordinating council under section 15.347 (13) (b) 8 of the statutes, as created by this act, shall be appointed for a term ending on July 1, 1987 ~~and the initial member appointed to the groundwater coordinating council under section 15.347 (13) (b) 9 of the statutes as created by this act, shall be appointed for a term ending on July 1, 1985.~~ (Vetoed in part)

(b) Following initial appointments under paragraph (a), members appointed to the groundwater coordinating council under section 15.347 (13) (b) 3 and 4 of the statutes, as created by this act, shall serve for the terms prescribed under section 15.347 (13) (d) of the statutes as created by this act.

160.50 Groundwater coordinating council. (1) GENERAL FUNCTIONS. The groundwater coordinating council shall serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The groundwater coordinating council shall advise

and assist state agencies in the coordination of nonregulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and the appropriation and allocation of state funds for research.

- (2) SUBCOMMITTEES. The groundwater coordinating council may create subcommittees to assist in its work. The subcommittee members may include members of the council, employees of the agencies with members on the council, employees of other state agencies, representatives of counties and municipalities and public members. The council shall consider the need for subcommittees on the subjects within the scope of its general duties under sub. (1) and other subjects deemed appropriate by the council.
- (3) REPORT. The groundwater coordinating council shall review the provisions of 1983 Wisconsin Act...(this act) and report to the legislature concerning the implementation of the act by January 1, 1989.



State of Wisconsin \ GROUNDWATER COORDINATING COUNCIL

Scott McCallum, Governor

101 South Webster Street
Box 7921
Madison, Wisconsin 53707
FAX 608-267-7650
TDD 608-267-6897

DATE: March 6, 2002

Susan L. Sylvester,
Council Chair
DNR

TO: Secretary Philip Edw. Albert - Department of Commerce
Secretary Darrell Bazzell - Department of Natural Resources
Secretary Phyllis Dubé - Department of Health and Family Services
Secretary James E. Harsdorf - Department of Agriculture, Trade &
Consumer Protection
Secretary Gene E. Kussart - Department of Transportation

Carol Cutshall
DOT

James Robertson
WGNHS

Nicholas Neher
DATCP

FROM: Susan L. Sylvester - Chair, Groundwater Coordinating Council

Henry Anderson
DHFS

SUBJECT: Agency Funding for Groundwater Monitoring and Research

Cathy Cliff
COMMERCE

Frances Garb
UWS

On behalf of the Wisconsin Groundwater Coordinating Council (GCC), I would like to thank you for your ongoing support and commitment to groundwater monitoring and research in the state of Wisconsin. Since 1992, the Department of Natural Resources, the Department of Commerce, the Department of Agriculture, Trade & Consumer Protection, and the University of Wisconsin System have participated in a joint solicitation for research proposals to enhance the understanding and protection of Wisconsin groundwater.

John Metcalf
GOVERNOR'S REP.

Each year, approximately \$600,000 to \$700,000 have been made available to UW System researchers, agency staff, the Wisconsin Geological and Natural History Survey, and other partners, with over half of that amount coming from agency sources. Benefits of these funds are wide-ranging, including:

- assessment of the arsenic problem in northeastern Wisconsin;
- developing alternative wastewater treatment methodologies to protect groundwater;
- guiding best management practices for use of pesticides and fertilizers;
- developing groundwater flow models to predict impacts of future water supply needs; and
- monitoring for the presence of new contaminants and contaminant sources, including landfills and hazardous waste storage sites.

We have recently learned that the DNR, DATCP, and Commerce will be only able to participate with the UW System in funding one new groundwater monitoring and research project in FY 03. As a result, just 7 of 38 proposals that were submitted will be funded, at a total of \$162,000. This is less than half of the usual funding level for new projects. We recognize that in times of fiscal shortfalls, agencies have to cut back on many programs, including monitoring and research budgets. However, we strongly urge you to make restoration of these funds a priority in future budget cycles. We believe that monitoring and research programs are fundamental to the long-term sustainability of Wisconsin's groundwater resource and drinking water supply.

For more information, please contact Tim Asplund, GCC staff person at (608) 267-7449 or asplut@dnr.state.wi.us.